ECONOMIC CLIMATE

INCREASING TEMPO OF DEMAND is moving almost all the primary indicators of economic activity into high ground. A seasonal upswing is reinforcing the cyclical growth trend, and the outlook is for continuing improvement for the balance of this year and on into 1962. Inventories have started to rise at a more rapid rate—but economic advisers to the Administration do not anticipate an inflationary upsurge. Deliveries are prompt, capacity is ample, and prices show only a slight rising tendency. This, of course, raises the question of the extent to which plant expansion can be counted on to spur business growth. Employment, though improving, has not whittled the number of unemployed significantly; the government still feels there are too many jobless. Farmers remain a bit of a problem, too. Though farm income is up from last year, it is still under a decade ago. To complicate this further is the fact that over the last 10 years average values of farmland went up about 65-percent, but average crop yields per acre increased only 30-percent.

NEW HIGHS in output and income probably will be reached during the rest of this year. In fact, it is probable that final third quarter figures will indicate a new peak. Personal incomes continue to move up, as do backlogs of unfilled orders and shipments and orders of durables. All in all, a gain of at least five percent—and probably more—is indicated for the total output of goods and services during the second half of this year.

MANAGEMENT VIEW

ELECTRIC UTILITY GROWTH was slightly (and temporarily) stunted in recent months when unusually cool weather affected a few systems in some parts of the country. This shows up in cut-backs from construction budget levels for a number of companies (such as Texas P. & L.'s). But, industrywide, this slowdown was offset, of course, by the impact of hotter-than-ever summer conditions on other systems. Companies also report favorable offset in Kwh sales by first-half gains (Middle South) and general economic upturns (Commonwealth Edison). (Out-West signs of continuing growth: So. Cal. Edison's record of doubling its generation rate every eight years, as reported in AIEE meeting; PG&E's proposal to build the $86-million, 330,000-kw hydro project in Shasta county, Cal.)

In the first half of '61, reports the FPC, electric utility generating capacity additions totalled 6.9-million kilowatts —a gain of 7.6-percent from a year earlier.

PUBLIC RELATIONS EFFORT of investor-owned utilities is getting reinforced attention nationwide . . . and new management awareness of more pressing needs is bolstering improving practices of the industry's PR-men. Newest exploration of present challenges came in the past week at the P.I.P. workshop conference in Denver, where the "climates" (political, economic and operating) were examined by a panel of three utility executives (R. T. Person, Albert A. Cree and Edmond W. Hebel) and a panel including representatives of press, investment, and regulatory viewpoints—"as others see us." And, two "pattern" speeches (adaptable by company speakers for local use)— "Aware of Your Power-Freda Enterprise," "From Edison to Energetics" were presented.

COST YARDSTICK IN INDIANA--Completion by P. S. Co. of Indiana and Indianapolis P. & L. Co. last month of a new substation and interconnecting transmission lines gave heads (C. H. Blanchar and O. T. Fitzwater) of the cooperating investor-owned companies an opportunity to compare its cost ($5.5-million) with the $60-million in tax funds the Hoosier Cooperative Energy, Inc. proposes to spend for a powerplant and transmission system to supply 17 rural co-ops in southern Indiana. Ten times more expensive, the proposed co-op plant would have 198,000-kw capacity; the transformer capacity at the newly proposed substation: 360,000-kw.

NEWS IN PERSPECTIVE

CHALLENGE OF GAS GENERATORS is not taken seriously by some electric utility officials, the "Wall Street Journal" reported recently. Arkansas P. & L.'s Pres. Paul O. Canaday is quoted: "It's still a lot easier to buy electricity than to own your own plant." But, Middle South Utilities' Edgar H. Dixon concedes: "It's a real competitive threat." Reports the Journal: "The big gas firms are hopeful" concerning on-site generation . . . as examplified by the gas-fueled, do-it-yourself electric generating plant meeting all requirements of a Little Rock, Ark., shopping center . . . without needing service from the local electric utility.

"PRODUCE TAX DOLLARS, not consume them"—this should be Electric Power's role, contends the Atlantic City Electric Co. in a "dramatic series of advertisements categorically telling this story to our customers and the public." Inserted every other week in southern New Jersey weeklies, the institutional type ads alternate with merchandising campaign advertising from Labor Day through Nov. . . . and Public Information Mgr. Wilson Meyers invites publishers and editors to comment editorially. First "hard-hitting message" appeared under headline—"Moscow Papers Please Copy: Tell Khrushchev I'll Bury Him!"

STAFF GROWTH PROJECTIONS are sufficiently accurate, now that Saskatchewan Power Corporation's growth has reached a levelling period, so that it is "feasible and essential to plan for a more adequate permanent headquarters." The Canadian utility noted this in its recent announcement that the third and final step was being started in constructing the $6-million head office building planned for occupancy in '63. (Corporation staff is presently housed in 11 widely scattered buildings in Regina.)

"PRAYER CHANGES THINGS—Prayer Changes You" was the first of a series of inspirational religious messages appearing on Florida Power Corp.'s big signboard in St. Petersburg in the past 10 years. Originator of the series of non-commercial messages was the utility's PR vice-president who conceived this method of sharing his belief in prayer and expressing thanks for recovery from a heart attack. Recently, the initial message was repeated . . . with the single added line: "In memory of J. K. 'Pat' Flanagan."

WASHINGTON INFLUENCE

AFTER UTILITY PROTESTS were received, the Interior Department decided not to impose a minimum charge of $5 per acre for rights-of-way over public lands. Fair market value of the right-of-way as determined by a Bureau of Land Management appraisal will be charged. Object will be to keep fees and user charges in line with value received—and periodic reappraisals will be undertaken.

CAPITAL OUTLAYS for electric utilities by state and local governments totaled $391-million in 1960. Total revenue of these utilities was $1,192-million. Costs of current operation were $693-million, and interest on debt came to $83-million. At the end of the fiscal year, these utilities had a total debt of $2,712-million, of which $166-million was backed by the full faith and credit of the issuer while $2,546-million was non-guaranteed. Construction expenditures accounted for $341-million of the capital outlay total.

INSTEAD OF FEDERAL SUBSIDY to TVA, says Sen. Estes Kefauver (D.,Tenn.), the "shoe is on the other foot." More than three-fourths of TVA's purchases of manufactured goods—$128.8-million—was spent outside the seven TVA states, putting money in the pockets of workers and industries far away. Moreover, lower prices have stemmed from TVA's "venting its outrage" at identical bids. By shaving bids, says the Tennessean, domestic manufacturers have recaptured the TVA market. TVA's purchases from abroad were $12-million in fiscal 1960; they now have dropped to a "comparative trickle" of $2-million.

STIFFER ANTI-TRUST LAWS proposed by Sen. Kefauver drew prompt and nearly complete endorsement from the Justice Dept.'s anti-trust division chief, Lee

bevinger. Exception: He opposed the roposal that price-fixing violations arry heavier penalties than other anti-rust offenses. (In utility anti-trust ctions, Philadelphia Elec. Co. added ive new suits to 11 previously entered gainst equipment suppliers. And, GE nd Westinghouse are reported to have aken further steps to stiffen rules for-idding employes to discuss equipment rices with competitors.)

PRIVATE DEVELOPMENT of the transmis-ion lines to serve the Upper Colorado iver Storage Project got a strong boost hen the Upper Colorado River Commission —appointed by state governors and the resident—unanimously endorsed construc-ion of the lines by private companies. Utilities have maintained that they can ransmit Colorado power under existing ines, saving the federal government an stimated $136-million in construction osts alone. They have also committed hemselves to reducing power wheeling harges as soon as capital investments ave been amortized, resulting in a urther saving put at $146-million.) he Commission feels sure that private tilities can meet the Reclamation Bureau's requirement of power delivery to load centers. . . . Meantime, Demo-ratic National Chairman John M. Bailey delivered himself of some intemperate charges against private utilities—and built up some more resentment against himself within his own party. Writing in a Democratic Party publication, Bailey said: "private power barons are spending in excess of $20-million to grab control of a billion-dollar taxpayer investment" —the Upper Colorado Project. High-ranking Democrats either declined com-ment on Bailey's tirade or indicated that the party had not informed them of it before publication in a party organ.

BOW-OUT OF J. M. LANDIS from the Administration inner circle last month could sacrifice further progress toward that part of Federal regulatory reform aiming at making the agencies more re-sponsible to the White House. This recalls comment of EL&P's Washington Editor Elliott on his page last January: "Landis, chief architect of the Kennedy strategy, is a strong advocate of the responsibility shift. His reason: 'The broad policy pursued by the agencies should fall in line with that of the Administration as a whole.' Of the many reform proposals, those aimed at making the agencies more responsible to the White House will bear closest watching."

ONE UNIT AT HANFORD PLAN contained in the compromise bill approved in the Senate, according to Rep. Van Zandt (R.-Pa.), is "no less objectionable to the House than the original plan which would have cost tax payers $95-million." Later, the House voted against even a single unit. (On page 37 of this issue, EL&P's Ralph Elliott calls "Hanford: A Pandora's Box.")

HURRICANE RADAR NETWORK set up by the Weather Bureau from Southern Texas to Maine, is in operation. Military radar units and private groups are also coop-erating to track storms during the last critical 12 to 18 hours of their approach to land. Utilities and government officials concerned with water supply and flood control expect to find the radar net useful in water management.

PUMPED-STORAGE hydro project for Yards Creek, N. J., is proposed by Jersey Central Power & Light Co., Morristown. Powerhouse would have installed capacity of 300,000-kw.

50-YEAR FPC LICENSE for integrated developments in Shasta County, Calif., goes to Pacific G&E Co. for a proposed $86.7-million project. McCloud-Pit, Pit No. 6 and Pit No. 7—for which company sought separate licenses—will be oper-ated as a single unit to produce 329,400 kw. FPC decided to put the hydraulically and electrically connected plants under one license.

$3.2-MILLION REA LOAN to Moon Lake Electric Ass'n, Vernal, Utah, will be used to rehabilitate the properties of Uintah Power & Light Co., construct dis-tribution line for 629 new customers and build two substations with a combined capacity of 4,750 kw.

CHEAP POWER FROM SIBERIA is a "major trend" in the USSR says a Moscow periodi-cal. Over the next few years, the flow of power will be from east to west in

order to use the vast resources of Siberia and Kazakhstan to develop industry in European Russia. A Siberia-Urals grid would also provide cheap power to the intermediate districts.

INDUSTRY SIFTINGS

NEWEST POWER INTERCHANGES in the Pacific Northwest, when completed in December, will add new links in Oregon, California, Washington and Idaho. Pacific P. & L. is building two 230,000-volt "backbone circuits," one 55-miles and another 43-miles long. The latter will bring power from the Brownlee and Oxbow Projects of Idaho Power Co. into the systems of both PP&L and Washington Water Power Co.

A-POWER PROJECT IN CALIFORNIA—a 375,000-kw station between Los Angeles and San Diego load centers of San Diego G.&E. and So. Cal. Edison—is still another joint undertaking for investor-owned utilities. Last month the San Diego company announced it was participating about in proportion (20-percent) to the size of its system load compared with the L.A.-based utility.

LOOKUP IN LIGHTING—Women, children and the engineers who improve (and measure) its brightness are more and more in tune with the trend to better and better lighting. Examples: In the one-year-old crusade to improve street lighting, more than 200 member groups of the General Federation of Women's Clubs have worked on this lighting area in their communities; numerous reports reach EL&P from schoolroom situations where awareness of indoor lighting is being spread—sometimes subconsciously, sometimes with new ingenuity—among generations of upcoming kwh-users; and from the "horse's mouth"—new offices in the United Engineering Center where the Illuminating Engineering Society will soon be relocated will enjoy the 200-footcandle level so long recommended by IES.

ADVERTISING IDEA FILE, distributed periodically by utility company members of the PUAA, is making the industry rounds in bright new dress. Advertising Exchange Committee Chairman Chas. B. Collard has added a dramatic appeal for the file by wrapping it in an eye-stopping fuchsia and gold cover.

FUEL-BURNING PLANT OUTPUT of the nation's electric utilities was up 4.2-percent in the first half of '61, reports the FPC. Coal consumption for the year ending July 1 was up 3.1-percent and coal stock on hand was virtually unchanged from a year earlier—sufficient to last 108 days. Adds the National Coal Assoc.: Coal furnished the energy for 66-percent of the electricity produced by steam-powered generating plants in the continental U.S. in 1960.

AUTOMATIC GENERATOR LOADING at Philadelphia Elec. Co. employing digital computer (Minneapolis-Honeywell) involves new computation concepts making the facility a "first-of-kind," according to Honeywell VP James S. Locke.

"ELECTRICITY—NO KA OI" (is the best) theme of the PCEA's eighth biennial conference, is expected to draw more than 400 delegates to Waikiki Oct. 26-27.

FRANCHISE VICTORY STRING of Arizona P.S. Co. reached a total of five in 1961, the utility marking up strong "votes of confidence" margins in communities served with gas or both electric and gas.

CIVIL WAR SITE MAP distributed by the Potomac Edison Co. to over 100,000 schools, tour and travel bureaus and Civil War groups has proved "a major factor" in bringing many thousands of visitors into the utility's four-state area to view battlegrounds.

NEW NEB.-S. DAK. INTERTIE linking Black Hills P. & L. Co. and Consumers Pub. Pwr. Dist. will be affected by recently approved 105-mile, 161,000-volt transmission line, on which construction will begin next year.

COPPER "BY THE NUMBERS"—A new system of numerical designations of brass and wrought copper metals has been adopted by the member companies of the Copper & Brass Research Assoc. A three-digit system was chosen "because it will not conflict with the four-digit designations already in use for steel and aluminum."

EL&P
ELECTRIC LIGHT AND POWER
THE MAGAZINE OF POWER-SYSTEM TECHNOLOGY

TECHNIQUES FOR LOCATING CABLE FAULTS

By CRONJE JASPER, SR., Engineer, Underground Transmission and Distribution, Construction Department, Commonwealth Edison Company

Widely varying conditions complicate the problem of locating faults on underground cable systems. Operating experience demonstrates need for development of special test methods and equipment.

GROWTH OF UNDERGROUND transmission and distribution systems continually adds to the complications and the factors involved in fault locating. To determine the most suitable methods for any particular system, it is necessary to thoroughly analyze all of the factors and relate them to each other.

In general, the same methods are effective on different types of installations. However, different equipment and techniques may be required. In a duct system, where the faulty cable is replaced between manholes, the necessity for the accuracy in pinpointing the fault is not as great as for direct buried cable, where it is necessary to dig down to the fault. Also, in a duct system, the cable is accessible in the manholes for exploration purposes, which is not true with direct-buried cable. Network feeders or lines with several branches and terminals add problems not experienced on lines between two terminals only. A line paralleling a heavily-loaded single-conductor cable may have sufficient induced a-c voltage to render an otherwise effective method useless. Some methods cannot be used on single-conductor cables that have the sheaths isolated with insulating sleeves and bonding reactors.

Terminal design of cable lines affect the efficiency of fault locating. Terminals that are not accessible, as in oil-filled switchgear or transformer compartments where test leads are not brought out, eliminate the use of some of the best methods and therefore materially increase the cost and outage time.

On a residential underground distribution system, isolating the fault between transformer vaults in order to rapidly restore service is a problem in addition to later pinpointing the fault to make repairs.

Types of cable have a great influence on the efficiency of various methods. Pilot wires and supervisory control cables require different techniques than power cable. Some equipment that is satisfactory on relatively short cables is inadequate on long lines. Conventional methods are normally more effective on solid-type insulation cable than on oil-filled cable due to fault characteristics.

Some tracer current methods are effective on multiple-conductor cable but not on single-conductor cable, since the conductor current cannot be distinguished from the sheath currents which may continue past the fault. Pipe-type cable requires special methods due to its construction and the manner of making repair.

Fault Characteristics Differ

The greatest single factor is the type of fault. Efficient fault-locating procedures must include methods and equipment to cope with any type of fault that may be encountered. Most methods are effective on low-resistance faults (50 ohms or less), but many faults are not initially low resistance and therefore require other methods, or must be reduced to a low resistance.

Normally, faults under water cannot be reduced below approximately 400 ohms, and therefore require different equipment than would be effective on low-resistance faults. Arcing faults present the greatest problems. These may occur in solid-type cable where the sheath is burned away to the extent that the arc is through the air, rather than through carbonized insulation. In compound-filled joints, the compound may become melted and non-carbonized compound may displace the carbonized path due to

Editor's note: This is the essential text of a paper presented by the author before the Protective Relay Engineers Conference, Illinois Institute of Technology, May 4-5, 1961.

the disturbance caused by the arcs. This action is especially true in oil-filled joints and oil-filled cable, where the oil washes away the carbonized path.

All of these are very difficult to reduce. At best, fault reducing is a long and tedious process, and should not be resorted to, if it can be avoided. It requires large and expensive equipment and requires having available large input-power supply. At present, there are methods available or being developed that eliminate the necessity for fault reducing, and materially reduce the locating time.

Other Factors Also Important

Selection of methods and equipment may depend upon many other factors. In an area where there is a large amount of water in the manholes, where the cable lines are in streets with heavy traffic, or where there may be ice and snow on the streets, measurement methods are very advantageous, at least to determine the approximate location.

Urgency for restoring the cable to service and the cost of fault-locating crews are large factors. A cable out of service does not help produce revenue, and reduces the reserves for other contingencies. Since locating and repairing are normally continuous operations, a large part is done on overtime. Any time saved in locating will affect a saving in the over-all cost. Training of personnel is important. Normally, the most efficient methods require the most technical knowledge and the highest degree of skill to use them effectively. Even with the best methods and equipment, experience and judgment are important factors. Anyone who has fault-locating as his principal endeavor, can become more proficient than if he is only occasionally involved in this type of work.

Fault Locating Methods

There are two general classes of fault-locating methods. The tracer-current methods place current on the faulty conductor, which leaves the conductor at the fault and returns over the cable sheaths or through the ground. The location is determined by exploring in the manholes, or over the surface of the ground in the case of buried cable. Exploring for the fault location is time consuming, especially if there is a large amount of water to pump or if the manholes and the streets are covered with snow and ice. On heavy-traveled streets it is sometimes necessary to defer the locating until after the rush hours.

In the measurement methods, the location of the fault is determined by measuring the distance to the fault from a terminal. This eliminates many of the disadvantages of the tracer-current methods, but has some disadvantages of its own. It requires that accurate records must be kept as to total length of the line and distances between manholes. For the resistance measurements, knowing the size of the conductor is important, especially if the line contains mixed sizes.

Tracer Current Methods

1. *Alternating current*—Most of the a-c methods use a modulated audio-frequency current, detected by a magnetic coil and a telephone-type receiver. It is effective on three-conductor cable where the conductor current can be distinguished from the sheath currents by the proper positioning of the coil around the cable. On single-conductor cable where this cannot be done, the sheath signals may extend past the fault, seeking a lower-impedance return path. The main disadvantage is that it requires a low-resistance fault, usually 50 ohms or less, since with higher-resistance faults the capacitance of the cable past the fault may cause signals which will give false indications.

2. *Interrupted Direct Current*—This method uses interrupted d-c supplied by equipment capable of producing 5 to 10 amperes at 10 to 20 kv. The location of the fault is determined by the direction of the flow of the sheath currents, picked up by means of probes and a meter, as shown in Fig. 1.

In order for this large amount of current to flow, the fault resistance must be low, which normally requires reducing. Another objection is the size of the equipment and the amount of power required. This makes it necessary to have permanent installations at the cable terminals, or truck-mounted equipment with its own power supply.

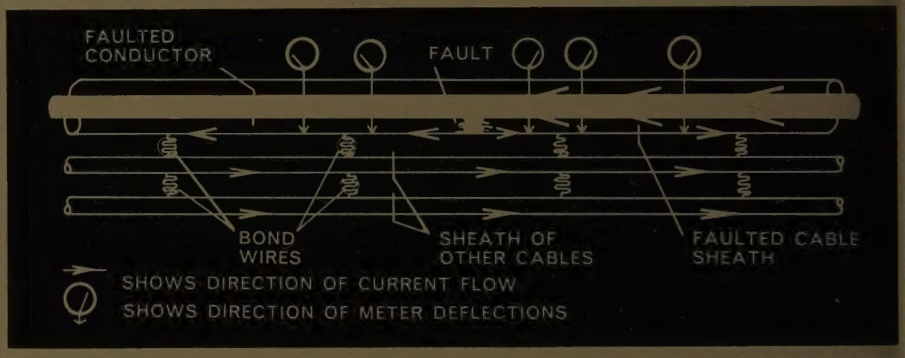


Fig. 1—Diagrammatic representation of interrupted direct current method in which location of fault is determined by direction of flow of sheath current.

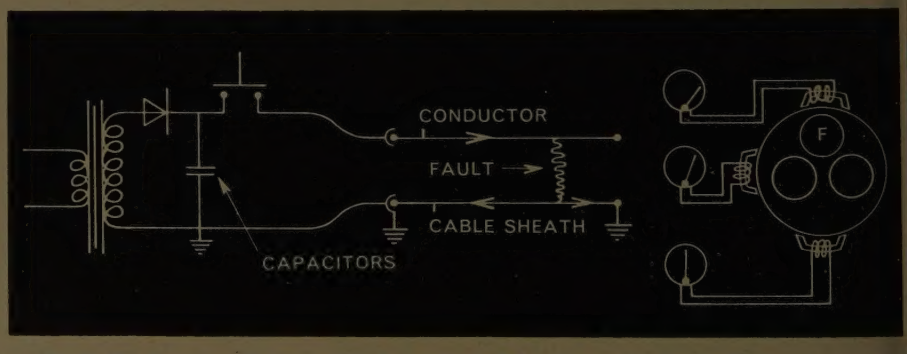


Fig. 2—The capacitor discharge impulse method of locating cable faults, illustrated here, eliminates the necessity for low-resistance faults.

3. *Capacitor Discharge*—The capacitor discharge impulse method, illustrated in Fig. 2, eliminates the necessity for low-resistance faults. The equipment is portable and requires low supply power. A capacitor is charged to high voltage and discharged into the faulty cable. This supplies sufficient voltage at the fault to cause a path to ionize and the full charge is dumped through the fault.

Originally, the fault was located by listening for the noise produced by the arc or by feeling for ground vibrations. In most cases this was effective if the approximate location of the fault was previously determined by a measurement method. Later detecting equipment was developed which permitted tracing the current from the terminal to the location of the fault. This consisted of a magnetic pickup coil, a storage circuit, amplifier, and a zero-center micro-ammeter.

This is effective on three-conductor cable since by properly positioning the coil, the conductor current can be distinguished from the sheath currents. It is ineffective on a single-conductor cable, since the sheath currents may continue past the fault, giving false indications. The detecting equipment is ineffective on buried cable, since the cable is not accessible. Therefore, feeling for ground vibrations is still the usual method, although work is being done to develop detecting equipment that will be more effective.

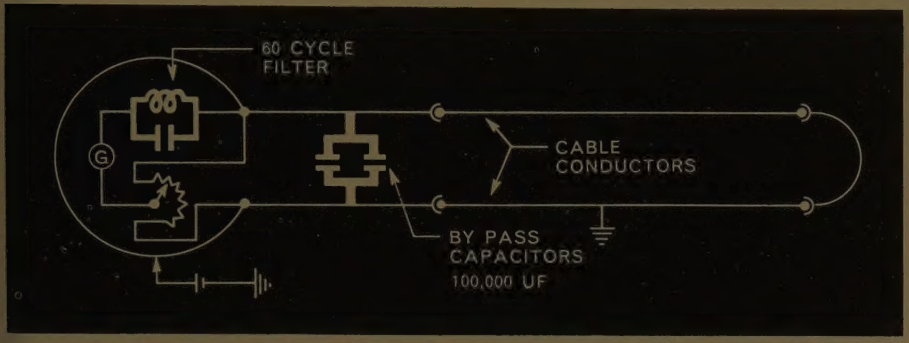


Fig. 3—This Murray Loop version of the resistance bridge has the widest use for locating cable faults.

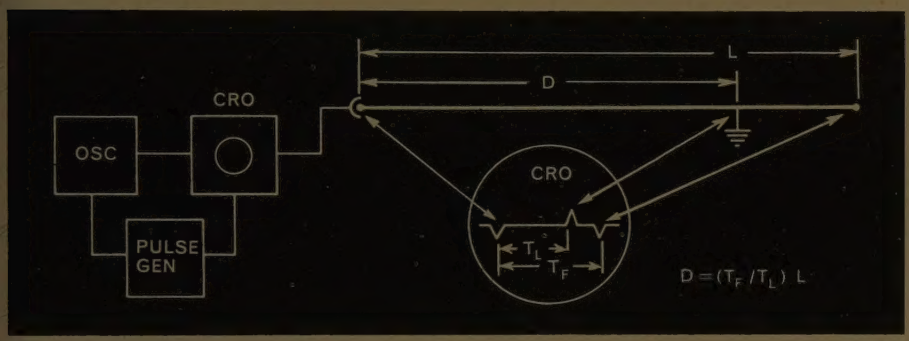


Fig. 4—Accuracy of the reflected impulse (Radar) method sketched here is about the same as the bridge method shown in Fig. 3.

Trials are also being made to determine if a directional sheath-current detector can be developed that will respond to the impulses and be safe to use with high voltages that may be on the sheaths due to the impedance of the return path. When this is done, this method will be effective on single-conductor cable and will be more positive than the magnetic coil when used on three-conductor cable. On high-voltage cable, where the arc-over voltage is higher than that availble with conventional impulse equipment, the impulse can be generated by charging the capacitance of the cable with any high-potential d-c testing equipment.

Measurement Methods

1. *Resistance Bridges (Murray Loop)*—Of the measurement methods, the Murray Loop version of the resistance bridge (see Fig. 3) has the widest use and can be applied to most installations and types of faults. There are two types of resistance bridges. One is the low-voltage high-current type which has the limitation that the fault resistance must be very low and normally they are not calibrated to give a high degree of accuracy. The other type is the high-voltage bridge, designed to use a low current of approximately 50 milliamperes and some may be used at voltages up to 100,000 volts. They are calibrated to read to 1/10 of one percent which gives sufficient accuracy for locating in a duct system and to give approximate locations on buried cable. The advantage of the high-voltage bridge is that it is not necessary to reduce the resistance of the fault to low values, and also, it gives better accuracy.

One problem in using the Murray Loop on single-conductor cable is the induced a-c voltages mentioned above. Initially, the effects of the induced voltage were reduced by placing a 60-cycle filter in the galvanometer circuit. However, with adjacent equipment carrying higher loads, the induction became so great that the slide wire would burn up. Lightweight high-capacity condensers have been developed to by-pass the induced current without affecting the accuracy of the bridge measurements.

2. *Reflected Impulse (Radar)*—This method (see Fig. 4) uses the principle that the elapsed time between a transmitted pulse from a surge generator and the reflected pulse is a measure of the distance to the fault or the end of the cable, as the case may be. This elapsed time appears as a time difference between the transmitted pulse and the reflected pulse on a calibrated trace on a cathode-ray oscilloscope. Calibration is facilitated by switching to a non-faulted conductor and using the end of the cable to adjust the calibration circuits.

Accuracy of this method is about the same as the bridge method. It is very effective where the conductor is discontinuous or burned in two at the fault. Where the con-

TABLE I

RESULTS OBTAINED ON CABLE-FAULT TESTS WHEN UTILIZING IMPULSE-TIMING TECHNIQUE

Line Number	Cable Size	Line Length	Time in Microseconds Calibrating	Fault	Error in Feet
6563	750 MCM	41,675′	182	53	—633
6232	2750 MCM	21,531′	114	64	+ 24
6232	2750 MCM	21,531′	114	100	—239
6231	2750 MCM	20,468′	109	58	—161

ductor is continuous, it is necessary for the fault impedance to be low (less than the characteristic impedance of the cable) in order for the fault indication to show on the trace. It is not effective on lines having several taps, since the reflection from the end of each tap would confuse the trace and also even though the distance to fault could be determined, it would not indicate the particular branch.

The combination of the high-voltage bridge, the reflected-wave method and the impulse tracer-current method provides means for efficiently locating most types of cable faults, leaving only the arcing-type faults as a problem. During tests and development work to determine the best methods for locating pipe-cable faults, it was decided that it was necessary to devolop other methods. These tests were reported in a paper in the October 1959 issue of the AIEE Power Apparatus and Systems. One of these developments was to provide a substitute for the high-voltage Murray Loop in case the faults were the arcing type.

3. *Impulse Timing (Time-Distance)*—Impulse-timing measurements were decided to be the best method for this, and it was thought that when it was developed, it could be extended for use on other types of cable. The location of the fault is obtained by measuring the time it takes for an impulse to travel from the fault to a line terminal. The impulse is supplied by raising the test voltage to the value that produces an arc-over at the fault.

The circuit is set up by short-circuiting the faulty phase to a non-faulted phase at the far end of the line (see Fig. 5). The time is measured by means of a calibrated oscilloscope. To facilitate reading the oscilloscope, a photograph is taken of the trace by means of a Polaroid camera. A new oscilloscope is now on the market that retains the trace. This could be read directly and would eliminate the necessity for the camera.

The sweep circuit is connected to the terminal of the faulty phase. The vertical amplifier circuit is connected to the terminal of the non-faulted phase. A calibration is made by applying a low-voltage impulse to the faulty phase terminal and measuring the time it takes for the impulse to complete the entire circuit. The location of the fault is then determined by raising the voltage on the cable until the fault flashes over. The time recorded then is the difference between the time that it takes for the impulse to return to the oscilloscope over the faulty phase, and the time it takes for the impulse to go to the other end of the cable and back over the non-faulted phase.

As may be seen, this method eliminates the necessity for reducing the fault, since the arc at the fault is used to make the measurements. Due to the infrequency of failures on high-voltage cables, only four trials have been made. Results are shown in Table I.

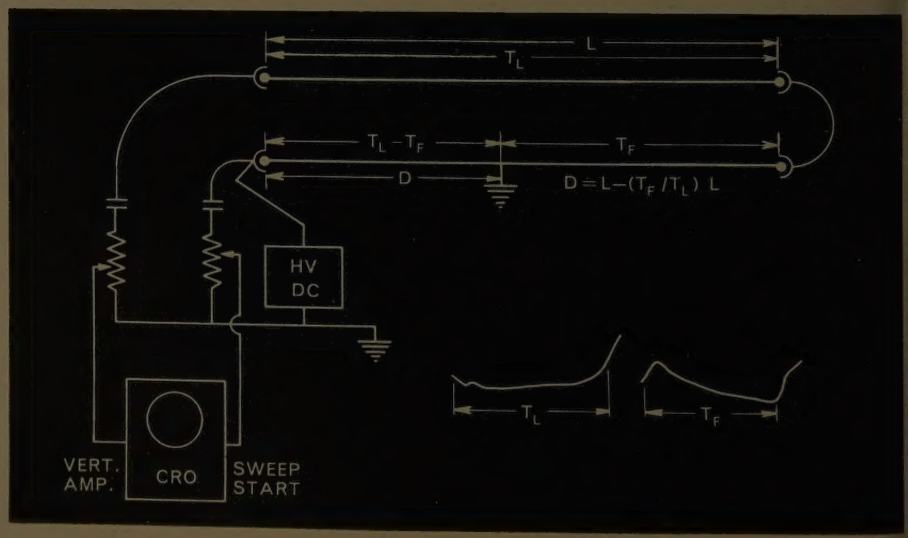
This is sufficiently accurate to give a location to explore for other indications of the failure. With the satisfactory development of the directional sheath-current measuring equipment mentioned previously, it could be used to pinpoint the fault after the approximate location had been determined by this impulse-timing method. This combination would give positive means to locate any arcing-type fault in a minimum of time.

4. *Sound-Distance Measurements*—The sound-distance measurement method is for obtaining a very exact location of a pipe-cable fault after an approximate location has been determined by electrical impulse-timing, or by a bridge measurement.

This is a variation of the electrical impulse-timing method. It depends on determining the time that it takes for the disturbance vibrations in the oil or gas to travel from the fault to the nearest manhole.

A crystal pressure transducer is installed in the joint in the nearest manhole. The sweep circuit is connected to the pipe and the vertical

Fig. 5—For measurement of arcing-type faults, the impulse timing method shown here can be used to advantage.



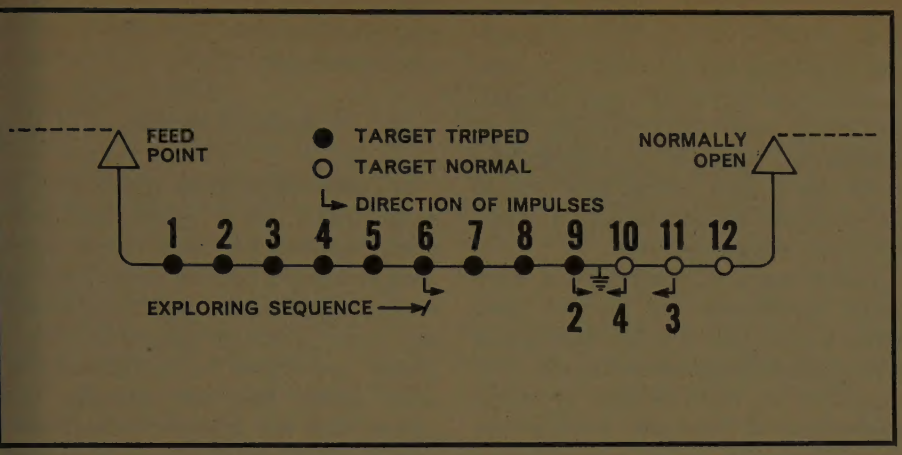


Fig. 6—Permanently-installed indicating devices provide one method of locating cable faults on residential underground distribution such as shown here.

amplifier connected to the transducer. When the fault is arced-over, the electrical impulse starts the sweep and the vertical change in the trace occurs when the vibration reaches the transducer. A similar measurement is made from the adjacent manhole on the other side of the fault and the ratio of these two readings gives the location of the fault. The accuracy should be within one or two feet.

Special Designs Necessary

Many American and also many foreign manufacturers of dielectric testers and electronic equipment have placed various types of fault-locating equipment on the market. Most of the standard equipment offered lacks capacity or special features to make it effective under all conditions and with all types of installations. Experience has shown that it is necessary to evaluate all the factors involved, and design special equipment, to meet the special requirements. For example, it was found that standard impulse fault locators were totally inadequate to locate faults under water on long network-feeder cables. In order to use this method on our system, it was necessary to have non-standard high-capacity sets built to order.

New Methods For Residential U.G.

With the growth of residential underground distribution, there is need for new techniques to rapidly isolate the fault between transformer vaults in order to restore service to the customers. The fault is located and repaired later. A research project is being carried on, to determine the best methods. Two general methods are being considered.

1. *Installed Indicators*—One method, illustrated in Fig. 6, would be to have permanently-installed indicating devices. The indicators would not operate at load currents, but fault current would be sufficient to cause operation in the vaults between the source and the fault, but not beyond the fault. All that would be necessary to isolate the fault would be to start at the supply source and check each indicator until one was found that did not indicate. The faulty cable would be disconnected in this vault and the next one back towards the source.

Devices of this type are being advertised by some suppliers. The main concern is their reliability. Since they have moving parts, the question arises as to the effect that time, moisture and corrosion will have on their operation. If complete dependence cannot be placed on their operation, they would be a liability rather than an asset. Reliability can only be established by actual use over a long period of time.

To reduce the cost and eliminate the moving parts, another device has been developed. It consists of a magnetic link placed on the insulation of the conductor. The load current does not magnetize the link, but the fault current leaves a residual magnetism. This residual is measured by removing the link from the conductor and placing it in the magnetic circuit of a special meter.

2. *Impulse Method*—The other method is to use portable test equipment that could be connected after the fault occurs, and would indicate the direction of the fault from any given location or vault. A relatively lightweight, battery-operated impulse transmitter has been developed for this purpose. The same type detector as used with impulse fault locators will be used to indicate the direction.

This new portable test unit can be operated satisfactorily on its own batteries for a 20-minute period or can be plugged into a 120-volt a-c source for continuous operation.

When the transmitter is connected to the faulted conductor, in a vault, the detector will indicate the direction of the fault. The transmitter produces an impulse every 20 seconds, and since only four or five impulses are necessary to determine the direction, less than two minutes will be required at each vault. On a circuit, with 12 vaults in series, the fault can be osolated by obtaining readings in four vaults.

In addition to providing a means for rapidly isolating the fault between the transformer vaults, this equipment could be used to later locate the fault for repairs and also to locate faults on other types of installations.

To convert it to a fault-locating set, it would only be necessary to provide auxiliary supply, which could be a 12-volt high-amperage storage battery or a 120-volt a-c service together with an a-c or d-c convertor. It would have more capacity than many standard impulse fault locators.

As power systems have expanded, the relay protection systems have not only become more elaborate, but faulted lines are being cleared faster. Consequently, there is less burning and less fault reduction at the time of the original failure. These faster relays have not only obsoleted the old "strong-arm" method of fault locating, but have forced a new era of technology upon us.

DESIGN OF A LIGHTWEIGHT SINGLE-CIRCUI

Four basic considerations contributing to economical but adequate design make it possible for a 138-kv lightweight steel tower to compete favorably against wood H-frame structures on a cost-per-mile basis.

By J. R. ARENA, Structural Engineer,
Sargent & Lundy

RECOGNIZING THE IMPORTANCE of constructing transmission lines economically, a midwestern public utility and Sargent & Lundy recently combined their efforts to produce a lightweight steel tower line whose cost would be comparable to that of a wood H-frame supported line.

Advantages of steel towers over wood structures are many. Steel has a longer life; it is not flammable and requires less maintenance. Acquisition of right-of-way is made easier and at less cost because no down guys are required and there are half as many structures per mile. This makes it easier to deal with the land owner and was proven in the acquisition of the right-of-way. Negotiations required less time than is usually spent on right-of-way acquisition because land owners were attracted to the small base dimensions of the tower and the capable appearance of a steel structure.

Basis Of Design

A lightweight steel tower line is defined as a line in which the "tangent suspension" structures have been designed for the same loading conditions that are used in designing wood H-frame supported lines. These structures on a lightweight steel tower line are usually designed only for transverse and vertical loads resulting from ice, wind and a zero-degree line angle.

The problem every tower designer must face is, "What is the minimum economic weight of a tower that is to be designed to withstand a specified set of loads?" This requires many studies for an optimum configuration and con-

Fig. 1—Narrow-base latticed pole structure desirable for restricted right-of-way.

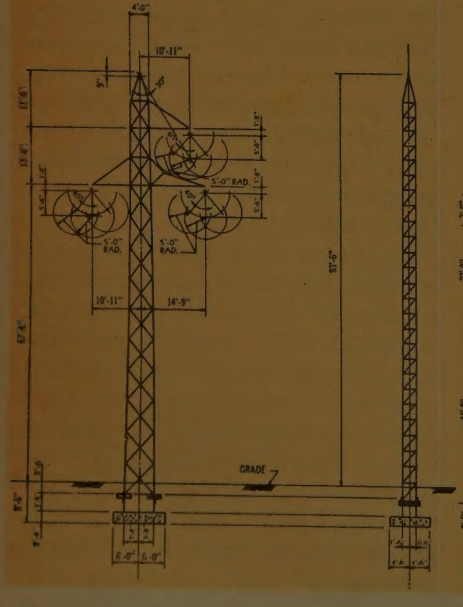


Fig. 2—Conventional waist-type structure with conductors in horizontalt configuration.

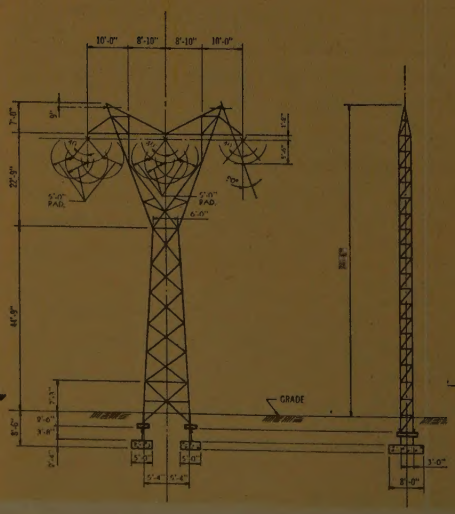
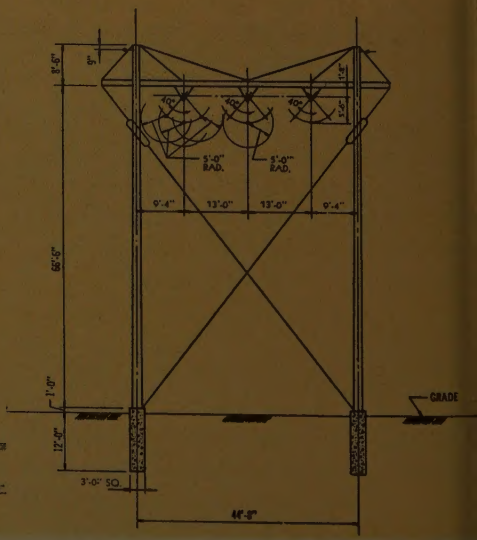


Fig. 3 — Steel-pole structure similar to wood-pole H-frame has tapered thin-wall tubes.



38-KV STEEL TOWER LINE

deration of various shapes and onfigurations while converging on n optimum design.

Several configurations were con-dered in this program before the hree schemes shown in Figs. 1, 2 nd 3 were selected for comparison. ig. 1 shows a latticed pole which ould be very attractive for a re-tricted right-of-way because of the arrow base. It requires only one round wire for shielding. Fig. 2 hows a conventional waist-type ower with conductors in horizontal onfiguration. Two ground wires re necessary here for required hielding. Fig. 3 shows a steel pole tructure similar to a wood pole tructure but using tapered thin-alled tubes.

Design Criteria

The following basic design crite-ia were used:

A. *Conductor Size* — 397.5 mcm 30/7 ACSR at 8000-lb maximum ension.

B. *Ground Wires*—159 mcm 12/7 ACSR at 6300-lb maximum tension.

C. *Line Angle*—Zero degrees.

D. *Insulation*—A 5 ft-6 in. string f insulators composed of nine 5¾ 10-in. units for all three designs.

E. *Shielding Angle*—The tower in Fig. 1 uses a 30-degree shielding angle; Fig. 2 shows a 20-degree shielding angle; and Fig. 3 has the shield wires outside the conductors.

F. *Clearances* — At a 40-degree insulator swing, a clearance of at least five feet to any part of the tower is maintained.

G. *Loading* — With the above clearances and configuration, the following loading specifications for all three schemes were selected.

Vertical—wires covered with ½-in. radial ice, 1400-ft span times an overload factor of 1.27.

Transverse—(no line angle)—four lb/sq ft on ½-in. ice-covered wires, 1100-ft horizontal span, no line angle and 6.5 lb*/sq ft of wind on 1½ times the projected tower face, all times overload factor of 2.54. * (4 lb/sq ft on the projected face of each pole on Fig. 3.)

Heavy Vertical—(no other loads) —wires covered with one-in. radial ice, 1400 ft vertical span times an overload factor of 1.27. Vertical and Transverse loads were applied simultaneously, Heavy vertical non-simultaneously.

These loadings are equivalent to 64 mph or wind on wires and structures; wire tensions are at zero-degrees F with ½-in. of radial ice; structures meet Grade B requirements of NESC fifth edition.

With the loading conditions selected, a rectangular structure was found to be the most economical for the towers shown in Figs. 1 and 2.

High strength steel was used to the extent of approximately 30 percent in Figs. 1 and 2. Cost of the steel pole structure shown in Fig. 3 did not compare favorably with costs of the towers shown in Figs. 1 and 2. In general, it was felt that the loading presented here can be handled more favorably by the structures in Figs. 1 and 2.

Comparison Of Design

Cost of the structure shown in Fig. 1 is very close to that of Fig. 2 even though more tower steel and higher footing costs are involved. It has only one ground wire and should be especially considered if the right-of-way is restricted such as along a road.

The structure shown in Fig. 2 is the conventional waist-type tower and presents a saving of $61.00 per mile over the Fig. 1 structure. Comparative estimated costs are shown in Table 1. No member in either Fig. 1 or 2 has a thickness of less than 3/16 in. There are published reports which state that ⅛-in. thick members are subject to breakage under actual service conditions even though these members performed admirably in a test.

Also shown in Table 1 is the estimated cost of a typical wood pole H-frame line. Cost of the wood pole line is approximately $1600 to $1800 a mile more than the cost of a steel tower line using either of the towers shown in Figs. 1 or 2. The wood pole line cost could be further reduced by using a smaller size ground wire, because of the shorter span used in spacing wood pole H-frame structures. However, this was not taken into consideration in this study. The greater cost of maintenance and replacement of wood poles should be added to the wood pole line costs. The possibility of fire, of course, is always present in a wood structure.

As a result of the study made on the three designs, the tower in Fig. 2 was selected and it was decided to redesign it so that it could be used at a two-degree angle in

TABLE I

COMPARISON OF ESTIMATED COSTS

(Level Ground, Approximately equal spans, no angle structures)

	Fig. 1	Fig. 2	Fig. 3	Wood Pole
Tower weight including footings (lbs.)	4527	4130	5265	
Structures/mile	4.8	4.8	4.8	11
Tower weight/mile, lbs.	21,730	19,824	25,272	—
Price/lb erected	20¢	20¢	31¢	—
Structure cost/mile	$4346	$3965	$7834	$6500
Footing cost/mile	$2380	$1800	$1270	—
		$5765		
Wire cost/mile (including hardware and insulators)	$6100	$7000	$7000	$8000
Total cost per mile excluding Right of Way, Clearing, and Top Charges	$12,826	$12,765	$16,104	$14,500

the line. This added weight to the tower, but it was felt that the versatility gained justified the change.

Tower Design

Design of 138-kv, Single Circuit Tower

Loading conditions were essentially the same as for wood H-frame structures except that the span was increased to 1100 ft and the tower was designed for a two-degree line angle.

Careful attention was given to all points that could contribute to reducing weight of the tower to the lightest economical weight possible, consistent with safety. A check on current prices revealed that high-strength steel having a yield point of 50,000 psi and an ultimate of 72,000 psi would cost only $25.00 per ton more than A7 steel. This slight difference made the use of high strength steel worthwhile in certain areas. It was found to be very economical in compression members of low slenderness ratio, making it ideally suitable for the legs.

Fig. 4 shows graphs plotted for the "yield point" compression formulae used subsequently in this paper for A7 steel and high-strength steel (50,000 psi yield). The "C" curve shows the Euler curve for pinned ends and the "D" curve shows the Euler curve for slightly restrained ends. The chart shows that for high strength steel members with L/r above 140 Euler's curve for slightly restrained members governs, and curve "B" can no longer be used. Hence, the economy of high strength steel becomes less and less as L/r values continue to rise. For values above L/r = 140, high strength steel is no better in compression than any other steel having a modulus of elasticity of 29,000,000, regardless of the value of the yield point.

Lacing members generally fall above the L/r = 140 range and therefore, they should be A7 steel. Since all stressed members are generally connected by a minimum of two bolts, the Euler curve showing slightly restrained ends can be used as a limit with a compression formula such as the 28,000 — 100 L/r formula used up to that point.

In members acting in tension only, high-strength steel can be economical only in highly stressed members. In low-stress members, the size of a tension member is generally controlled by the bolt connection requirement and L/r considerations.

Redundant members are chosen primarily for their L/r ratios and, therefore, there is no point in using high-strength steel for them. Because of factors such as these, it is not economical to design a tower entirely of high-strength steel.

Fig. 5 shows the comparison between high-strength and A7 steel required for compression members by plotting the relationship between compression slenderness ratio, L/r, and K, where K is defined as the ratio of area of high-strength steel required to the area of A7 steel required.

The loads present during the operating condition are due to:

1. ½ in. ice covered wires times 1.27.
2. Wind on wires at 4 psf times 2.54.
3. Wind on tower at 6.5 psf times 1.5 times exposed surface times 2.54.
4. Transverse pull due to wire tension for 2 degree line angle times 1.65.
5. Weight of tower times 1.27.

Fig. 6 shows the tower with all of the operating condition loads applied. Note that the tower was designed for no longitudinal strength when used at a two-degree line angle and with a span of 1100 feet. However, if the tower is used at either a lesser line angle or a re-

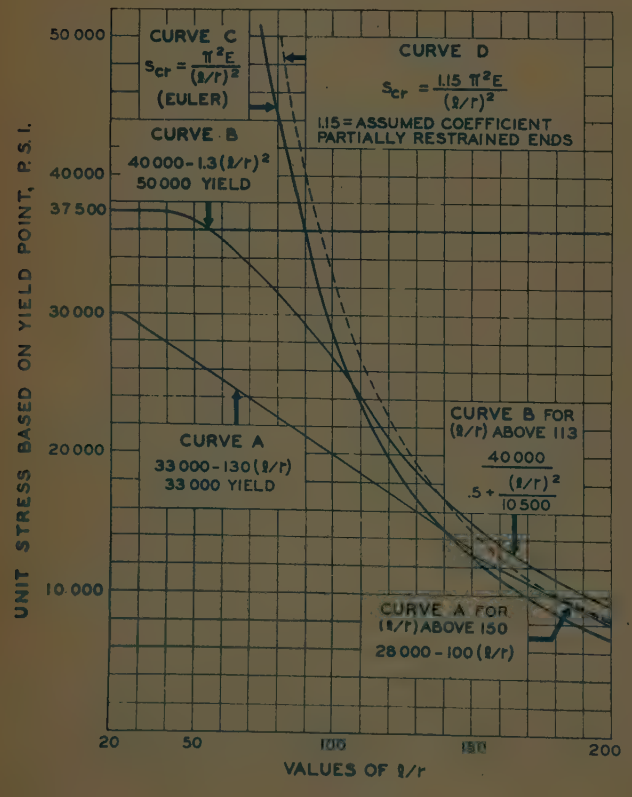
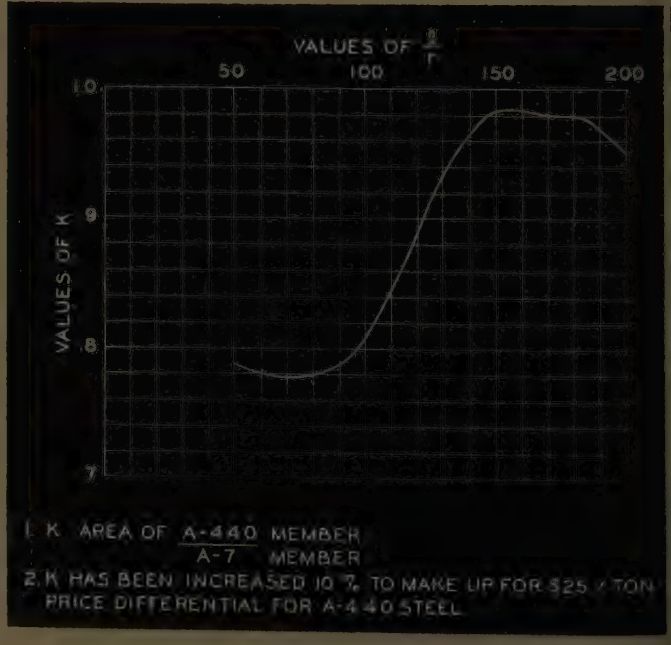


Fig. 4—(Left) Compression curves based on Euler's A-7 and high-strength steel formulas.

Fig. 5—(Below) Comparison between high-strength and A-7 steel required for compression members.



ced span or a combination there- it will have some longitudinal rength. The magnitude, of course, dependent on how much the line gle and/or the span is reduced. is longitudinal must be a sym- etrical load and not one that will oduce torsion.

Fig. 7 shows the heavy vertical ading condition on the cross arm. is loading condition is applied to ch cross arm with no other load ting and consists of the weight of e wires covered with one in. of dial ice times 1.27.

It is apparent from these loading nditions that the tower need not e as strong in the longitudinal rection as in the transverse direc- on and after considerable investi- tion, the shape shown in Fig. 6 as selected, utilizing a rectangular oss section, as being the most conomical. A basic height of 67 ft- in. to the cross arm was selected. the transverse direction, a base idth of 10 ft-8 in. was selected as eing the most practical. This gave excellent compromise for the roblem of leg size versus lacing length. As the tower base spreads out, the leg loads become smaller, but the lacing members become longer. Somewhere there is a balance between the two, and 10 ft-8-in. was calculated to be the most desirable. Since longitudinal strength was not a requirement, a dimension of three ft was selected for the width of the tower.

Pattern of Bracing

A compression system of bracing was used since this was found to be the most economical. This system was carried down to the junction between the tower body and legs, and a tension system was used for the leg extensions.

Redundants were placed at the most advantageous position in order to reduce L/r in other members so that their weight was more than compensated for by the saving in the member braced.

Allowable Stresses and Other Design Criteria Used

The following formulae were used for the design of compression members using A7 steel:

$f_c = 33{,}000 - 130\ L/r$ for L/r up to 150
$f_c = 28{,}000 - 100\ L/r$ for L/r = 151 to 200

with a maximum of 30,000 psi. This is based on the AISC compression formulae for other structures with an increase in the allowable stress by the same ratio that the allowable tensile stresses for towers are increased over the allowable tensile stresses for buildings.

Formulae for high-strength steel with a yield point of 50,000 psi are as follows:

$f_c = 40{,}000 - 1.3\ (L/r)^2$ for L/r 44 to 113

$f_c = \dfrac{40{,}000}{.5 + 1/10{,}500\ (L/r)^2}$ for L/r 113 to 200

f_c maximum = 37,500 psi

Maximum L/r in tension members was established at 500 and allowable tension stress was set at 33,000 psi for A7 steel, and 50,000 psi for high-strength steel. These values are the theoretical yield points of the two classes of steel.

Tower Test

To our knowledge, we do not know of any tower line in service that is designed to support one circuit 138 kv with two ground wires, with no provisions for sustaining a longitudinal load incurred by a broken wire. Therefore, in order to gain operational background in a very short time, the tower was

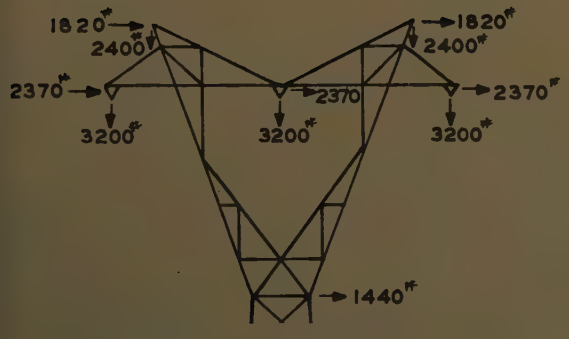


Fig. 6—Tower with operating condition loads applied.

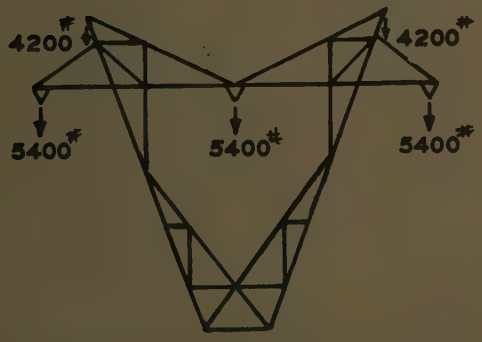
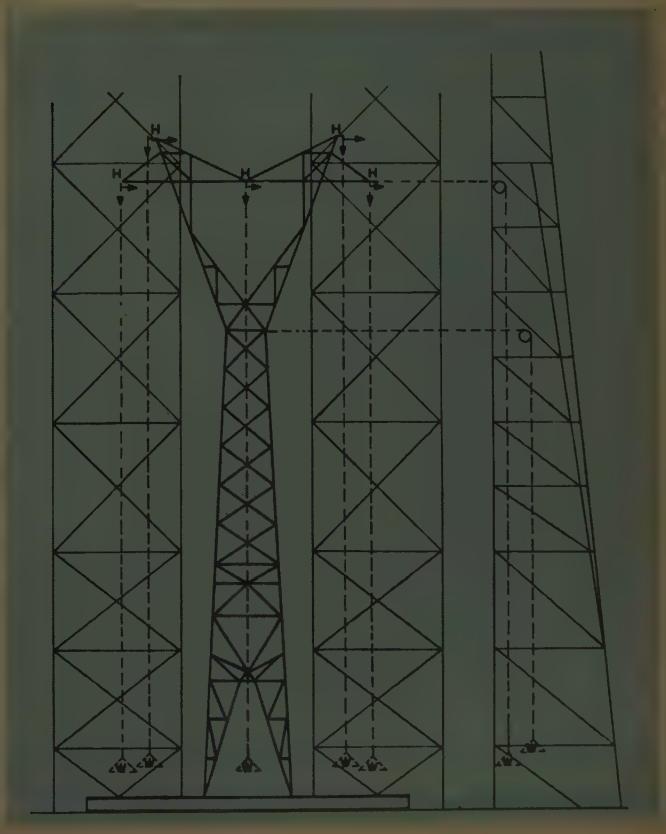


Fig. 7—Heavy vertical loading condition on cross arm.

Fig. 8—(Below right) Rigging used for applying vertical and horizontal loads during tests.



tested to failure on a full scale basis. There are numerous assumptions made in the design of a new type tower that need verification by means of a test. For instance, no reduction in area is made to allow for the fact that an angle is connected by only one leg instead of both legs. The assumption is also made that the stress is uniformly distributed over the cross section of the angle. Although in preparing a careful design, the designer will make every effort to minimize the eccentricities in a joint with their resulting moment, it is not always possible to achieve this and only by a test can the true behavior of a joint be predicted. Compression formulae are empirical and formulated for symmetrical sections such as I-beams and wide flange shapes. Judgment, experience and tests are valuable aids in applying these formulae to unsymmetrical shapes, such as angles.

It must be borne in mind also, that a tower is a pin connected structure composed of unsymmetrical members, and it is presumable that no member is ever subject to the entire calculated stress because of contributions by other parts of the structure that is impossible to evaluate by calculation. Therefore, it is evident that a full scale test is needed in order to observe the tower's ability to sustain the specified loads.

A multi-span steel frame, at right angles to the tower, was used to provide the anchorage for the transverse pull. Fig. 8 shows the tower and rigging used for the vertical and horizontal loads. Loads were applied in increments of 50, 75, 87.5 and 100 percent of total load. Vertical loads were applied by suspending trays filled with steel slab weights. Transverse loads were applied by an electric winch. Each increment of load was held for five minutes and the transverse deflection was observed with a transit. With 100 percent of the operatin loads applied, the measured deflec tion was 16 inches.

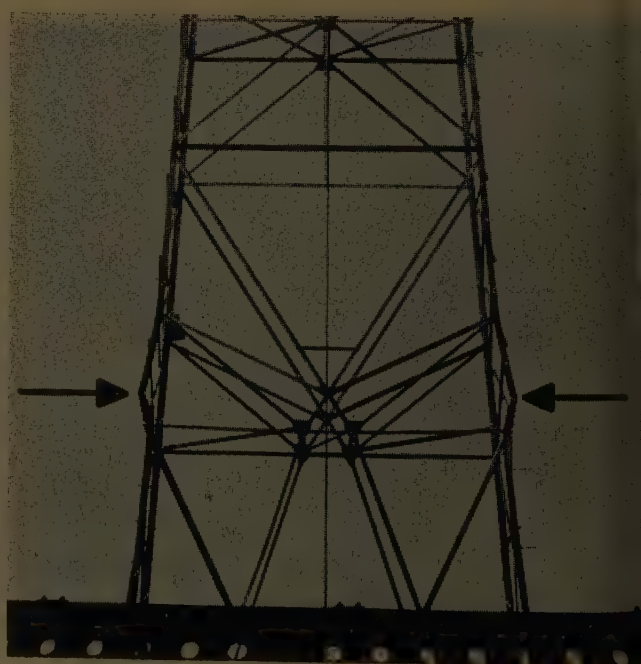
After completion of tests for op erating loads, vertical loads wer held constant and transverse load were increased in increments c approximately 90 lb each. Th tower failed in the long compres sion member in the waist interio as shown in Fig. 9. Measured de flection at the time of failure wa 18¼ inches. The tower successfull passed all tests, and failed at a fiv percent increase in the specifie transverse operating load.

In order to secure data for cal culation of the tower's longitudina strength that would be present i a reduced span and/or reduced lin angle were used, the tower wa then tested longitudinally with n other loads applied. It failed at combined longitudinal pull of 4,19 lb.

Fig. 10 shows the leg failure t longitudinal loading. Measured de

Fig. 9—(Left) The long compression member in the waist interior failed under heavy transverse loading.

Fig. 10—(Below) Heavy longitudinal loading caused leg-member failure.



ion at failure was 39½ inches.

ction and Cost

even of these towers have been ted and are in service. They e erected easily and efficiently ssembling them on the ground flat position and then hoisting entire tower upon the pre-sly erected foundation. Fig. 11 trates this.

everal extras not originally con-plated added 900 lb to the ght of the tower. However, even these added extras, such as itional ladder bars, anti-climb-devices, and providing strength uired for the two-degree line le, the tower compares favor-with the cost of a wood rame structure. The tower can be used to support a heavier e, 900-mcm ACSR with a span 00 ft at a two-degree line angle no reduction in the overload or.

ollowing is a breakdown of direct costs for erecting in place one of the towers with a five-ft leg extension (in a dry hole), making the ground-to-cross-arm height a distance of 72 ft-6-in., or a total tower height of 79 ft-6-in.

TOWER WEIGHT including foundations	6090 lb
FOUNDATIONS including lay-out, assembly, excavation, setting, concrete, backfill and truck	$ 259.00
TOWER ERECTION including loading, hauling, unloading, assembly, erection and truck (6.48¢/lb)	367.00
MATERIAL COST fabricated and delivered	853.00
TOTAL COST of Tower In Place	$1,479.00
TOWER COST PER MILE (actual) (79 ft-6-in. height, two-degree line angle 1100 ft span)	$7,100.00
OR	
(99 ft-6-in. height, 0 degree line angle 1373 ft span)	$6,764.00

Using the above actual tower costs together with estimated costs for wires, hardware and insulators, the revised estimated cost for the line as compared to the cost of a wood pole line is shown in Table II.

Conclusion

It has been demonstrated that a 138 kv lightweight steel tower can compete favorably against wood H-frame structures on a cost-per-mile basis. This was done by designing the steel tower as economically as possible by considering the following items:

A. Selection of design loading conditions comparable to the anticipated loads rather than provision for every remote condition, such as a broken wire.

B. Extensive studies of various configurations to achieve optimum strength with a minimum, economic weight.

C. Careful selection of individual members to insure the minimum, economic size.

D. The use of high strength steel wherever it proved to be economical.

TABLE II

REVISED ESTIMATED COMPARATIVE COSTS

	79'-6" Steel Tower 1100' Span—2° Angle	Wood Pole 480' Span—0° Angle
ver Cost Per e Incl. Footings	$ 7,100	$ 6,500
re Cost Per Mile cl. hardware and ulators)	$ 7,000	$ 8,000
TAL COST per mile cluding Right-of-Way, aring and top charges	$14,100	$14,500

Fig. 11—Tower is lifted fully assembled (below) and (Fig. 12) lowered to final position on foundation (right).

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LAMBERT, Pennsylvania Electric Company,
and A. J. TIGGES, Jackson & Moreland, Inc.

RESEARCH ANSWERS SERIOU

STEP-BY-STEP SOLUTION the complex problem of contro ling stack emissions at Penelec Seward Generating Station involve a four-year study of all aspects the problem from the coal pi through the plant to the communi affected.

The situation at Seward built u gradually over a 35-year period, an became an air-contamination pro lem which reached a peak four yea ago. It probably parallels many sim ilar situations throughout the cou try where station capacities hav increased radically due to the do bling of demand about every te years.

Seward Generating Station is l cated on the outskirts of the borou of Seward, Pennsylvania, about s miles northwest of Johnstown. It a coal-fired, mine-mouth operatio the coal being high in ash conte (18 percent average) and high sulphur content (4 percent ave age). The station is located in broad valley subject to freque stagnations and ground fogs. It ha 12 boilers, numbered 1 through 12, 14, and 15, supplying steam five turbine-generator units with net capability of 280 megawatts.

When engineering studies ind cated that a new unit of approx mately 140 mw should be added

Fig. 1—This view of the Seward Generati Station, taken in 1958, is typical of the previo year and shows that the station was produci an appreciable amount of smoke.

A four-year research and development program costing well over $2-million has solved a serious air-pollution problem created by stack emission from Penelec's 280-mw Seward Generating Station.

TACK-EMISSION PROBLEM

ward in the Spring of 1957, design ovisions for dust collection were ven considerable attention. After uch study and debate, it was de-led to install electrostatic precipi-tors in preference to mechanical llectors. A collection efficiency of percent was specified. A 200-ft ack was considered to be adequate t it was planned to increase exit-s velocity from 5 or 6 feet per sec-d to the range of 30 to 35 feet per cond. There was considerable con-rn about the extra horsepower quired for the induced-draft fans, d about disposition of the in-eased amount of fly ash.

After about one week of operation the new unit it became apparent at changes would have to be made. ctual efficiency of the precipitators as about 70 percent instead of the percent specified, and with this e stack handling more gas than e rest of the station combined, this eated a problem. In an effort to crease precipitator efficiency, wer supply to the precipitator as doubled, model tests were made the inlet sections to study gas and ist distribution and indicated mod-cations were made.

The basic modifications required r the boiler were the addition of echanical collectors ahead of the ecipitator and the installation of nozzle on the stack to boost the scharge velocity to 120 feet per cond.

By the middle of 1957 stack ap-arance had been improved but as still not satisfactory, and it be-me obvious that the situation lled for specialized technical as-tance. Penelec promptly initiated continuing program for evaluating d controlling stack emissions, and coordinate it engaged the Boston consulting engineering firm of Jack-son & Moreland, Inc.

Corrective Action Taken

These studies disclosed that it is essential to remove solids from the flue gas down to about 0.02 grains, or less, per standard cubic foot. This produces an essentially clear stack. For best results, the clean flue gas should be jetted into the atmosphere at velocities of 120 feet per second or more, from a tall stack. Cleansing of the flue gas aids materially in obtaining good jetting action.

For the present, the only practical and reasonable solution to the sulphur gas pollution problem is to discharge the stack gas high enough and with sufficient temperature and velocity so it remains considerably above ground level long enough to have the SO_2 concentration materially diluted and reduced through atmospheric diffusion. Removal of substantially all the solids eliminates the dust and fly ash nuisance and greatly reduces the amount of SO_3 discharged.

Emission Drastically Reduced

Corrective measures instituted as a result of this program have caused a reduction in the fly ash emission from the whole plant from 33,500 to about 1000 tons per year. Boilers No. 12, 14 and 15 emissions have been reduced from 30,000 to 760 tons per year. Because of these reductions, the associated air-borne nuisances now are negligible.

Results of the project to date have shown that high-ash, high-sulphur coal can be burned in large quantities without creating an air nuisance; that SO_2 is not as irritating as is commonly supposed; and that SO_3 and particulates coupled with high relative humidity in the atmosphere create the conditions to which people object.

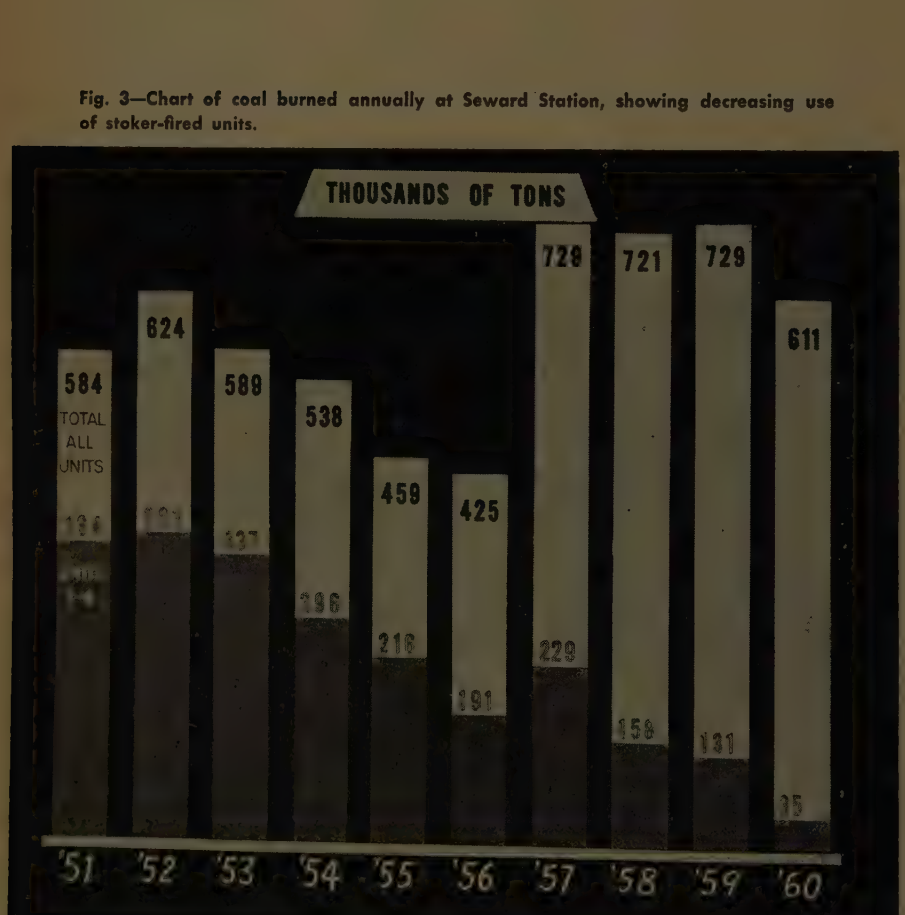
Development of an extensive air-

Fig. 2—Improvement over conditions shown in Fig. 1 are evident in this view taken at 2:30 p.m. on Jan. 20, 1961.

Dust Collector - No. 12	Dec. 1949
Dust Collector - No. 14	Feb. 1950
Dust Collector - No. 9	Sept. 1953
Electrostatic Precipitator - No. 15	April 1957
Additional Power - No. 15	June 1957
Modification of Inlet Flue	Nov. 1957
Vibrating Screen - No. 9	May 1959
Mechanical Dust Collector and Stack Nozzle - No. 15	May 1959
Electrostatic Precipitator and Stack Nozzle - Nos. 12 & 14	Sept. 1959
New Dust Removal System	April 1960
Flue Gas Temperature Control System, New Ash Hopper, and 33% Increase in Precipitator Power Supply - No. 15	Sept. 1960
Flue Gas Temperature Control System Nos. 12 and 14	Feb. 1961

Fig. 4—Summary of improvements made at Seward Station to reduce air contamination at ground level to an acceptable value.

Fig. 3—Chart of coal burned annually at Seward Station, showing decreasing use of stoker-fired units.



sampling program provides a c
tinuing guide for making correct
changes in the operation of the s
tion. This use of field instrume
as a guide in boiler operation i
pioneering approach to the solut
of utility air-contamination pr
lems.

Since generating stations ne
large quantities of cooling wa
they are necessarily located in v
leys. It is felt, therefore, that
results of these studies will be
value both for other plants on
Penelec system and for the indus
as a whole. As a matter of fa
Penelec is now modifying its Sha
ville Station to incorporate
features it has found to be m
important to air contamination c
trol.

Gains Are Manifold

Summed up, Penelec has sp
approximately $2,300,000 at its Se
ard Station on stack-emission c
trol or related projects necessary
keep ground-level contaminat
within satisfactory limits. There
compensating factors in addition
good public relations, since this
penditure reduces the maintena
formerly required, extends cons
erably the life of equipment
volved, and results in a cleaner
tion. Last, but by no means mino
value, is the knowledge and expe
ence which has been gained
application to future units both
the Penelec system, and for ot
utilities. The ever-increasing size
generating stations makes it impe
tive to know how to employ est
lished criteria both in design
maintenance, so that in operat
the station will be a good neighb
immediately and continually.

Not only has Penelec's anti-
contamination program establish
the company as a good neighbo
communities adjacent to its pla
but it also has helped create a des
on the part of the residents to ma
their home towns more attracti
It has made it possible to more
gressively promote a program
turning coal into electrical energy
the mines and transmitting it
centers more suitable for manuf
turing activities, thus contribut
to the economic regeneration of
area which has been chronically
pressed by the changing tech
logical picture.

Changing transformer without benefit of rubber gloves or any other protective equipment.

Stringing new conductor under and adjacent to energized primary while standing on unprotected telephone messenger.

Climbing over top of pole. No protective devices on energized conductors.

Contacting unprotected series street lighting circuit above rubber gloves.

Working above unprotected primary risers and cutouts. Rubber gloves and sleeves not being worn and shirt sleeves rolled.

Attaching grounding conductors while standing in hazardous position.

STOP SHOCK! !

vestigate Accidents Before They Happen

LYLE A. WESTROM,
ety Consultant, Middle West Service Company

TO STOP SHOCK and other injuries, why not — "investigate" cidents before they happen?

In recent observations of linew operations of many electric ility companies throughout the nited States, linemen in every mpany were performing some of eir work in exactly the same manr in which others have been led! All of these crews and their remen knew that they were being served by safety men.

If allowed to continue their unfe practices, a slip, a distraction, a itching error or any slight, invertent miscalculation will add to e increasing number of fatalities thin utility companies each year. Reports of the Accident Preven-n Committee of the EEI read the me every year: "Made contact with unproctected primary jumpers; working on underground lines thought to be dead; made contact while belting in—fell to ground—not wearing rubber gloves; working in de-energized section of substation — moved into energized section and contacted live equipment." It is always relatively simple to pinpoint an unsafe working condition *after* an accident but there seems to be some barrier to reaching the same, simple conclusion *before* an accident occurs.

Why does management allow these conditions to exist year after year? Why do competent foremen observe their men performing unsafe practices day after day and make no effort to demand correction? The fact of the matter is that for the most part they simply do not recognize these practices as being unsafe. The men persist in these work habits because they do not know that they are constantly endangering their own lives.

Basically, linemen and other utility company employees, with few exceptions, are hard-working, conscientious, loyal, and above all, *safe* workers. They *want* to do what is right. They *want* to be safe workmen. But many times they just don't know *how*.

In an effort to raise the standards of safety for electric utility companies, the Bureau of Safety, a subsidiary of the Middle West Service Company, is installing safety programs on a continuing basis for companies throughout the country. Safety investigators observe safe and unsafe working methods. They watch for adequate use of protective devices, correct sequences for performing work, safe and unsafe tools and equipment, and more generally unsafe work practices. In other words, they make an analysis or "investigation" of injury-producing conditions *before* an accident occurs.

(Continued on page 62)

Charts By The Thousands . . .

Tell Industry Story In Simple, Clear Sell

"The industry story" is being told nationwide these days . . . by more people, to more people, with more facts and more force than it has ever been told before.

A number of investor-owned electric utility companies recently indicated that they wanted a simple clear account of the vital role this industry is playing in the American economy for use with employee groups, civic clubs, and others in the communities. In response to these requests, and for member-company use, the Edison Electric Institute has developed a program which includes turnover charts, a four-color booklet, film strips and slides to tell the industry story.

National kickoff for the presentation was arranged through a conference for the news and industry press in New York on Sept. 11. (At that time industry spokesmen also described 1970 power transmission plans for the investor-owned electric utility companies.)

The presentation of the industry story through charts and associated materials is the culmination of research and effort over a long period, in response to the request of many utility companies, according to EEI Managing Director Edwin Vennard. After viewing the presentation in its meeting last June, the EEI board of directors directed that it be printed and made available to member companies.

A key item of the presentation materials is the 24-page booklet. Costs range from 30-cents each for under 100 copies to 15-cents apiece in quantities of over 5000.

The booklet contains the charts and text included in the desk-top presentation. (The charts are also being supplied in color as a film-strip or on glass slides.) Companies plan to distribute booklets: to employees, to members of audiences following meetings, and to customers calling at various office locations.

An early check showed that companies are using or plan to use the presentation materials in various combinations with many different groups in local or regional areas. These methods of presentation have been considered by a number of companies:

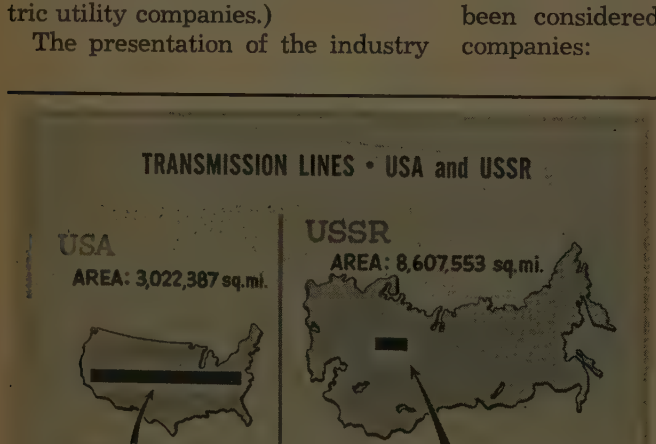
1. *Individual* demonstration desk-top chart series to principi opinion leaders, editors, comment tors and other major communi figures by the company president t "appropriate" top executive.

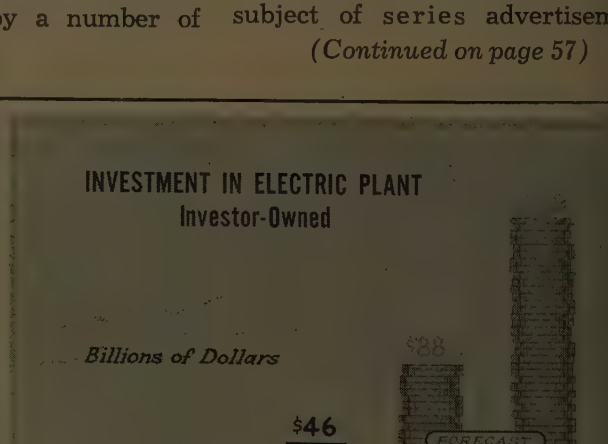
2. Conference sessions, either part of established employee infd mation programs or as special mee ings, will be arranged to reac groups of 20-30 employees at a tir in coverage of all utility organizi tion personnel.

3. Luncheon and dinner progra for civic clubs and other communi groups can be planned where speak ing assignments are handled company representatives especiall trained in story-telling techniqu

Utility companies also anticipa using the presentation for stoc holder and financial meetings, f delivery to high school and colle economic and science classes, f PTA meetings, as well as for mee ings and conventions of area utili associations and other industri held in company service areas. T booklet will undoubtedly find wi use as a giveaway at open hous and similar special events, while t charts have been proposed as t subject of series advertisemer

(Continued on page 57)





Typical of the series of charts in EEI's "desk-top" version of its new industry story presentation are shown above. Copy reads (for chart at left): "Although Russia has about three times the area of the USA, the United States has about five times the miles of transmission lines of the Soviet Union." For chart at right: "The investment in utility plant of the investor-owned electric power industry now amounts to $46-billi It is expected that the investment in 1970 will be $88-billion, or nea double the investment of 1960 . . . and about double again by 198 Not in companion booklet but in press conference presentation w chart showing $7.3-billion new investment in transmission facilities.

WASHINGTON OUTLOOK

BY RALPH ELLIOTT
WASHINGTON EDITOR

Hanford: A Pandora's Box

Fierceness of the political combat ver the Administration's proposal put the Atomic Energy Commis- on in the electric power business, a installation of some 800,000-kilo- atts of generating capacity at the overnment's Hanford plutonium roduction plant, has made it un- mfortably clear that this project is ut a part of a vast program being eced together in Washington to ep up the pace of federal encroach- ent in the electric utility field. The ake of the Hanford battle so far alive with indications that master lanning toward socialization of the ower industry is on the march gain. Taxpayers, investors, and merican free enterprise traditions us are in danger of being further ampled.

As for Hanford alone, the public ower advocates of spending $95- illion to add the generators are ell aware that utilization of the eactor's low-pressure, saturated team for power production would, easured by modern industry stand- rds, be somewhat of a scientific ud. Also, they know that Hanford ower would be high cost power— ut of the ballpark competitively nder any honest formula of cost llocation. True, these factors need ot be too worrisome when the gov- rnment is the operator; for tax- ayer-financed subsidy, government ower's corner stone, is the ready qualizer. Even so, it is obvious that Hanford, by itself, would be no shin- g light in the public power domain.

The fact has become abundantly lear that the New Frontier power lanners and their government own- rship allies are by no means push- g Hanford for Hanford's sake lone. The project is the key they ould use to unlock a parade of dditional federal undertakings pat- rned as links which eventually ould be forged into a nation-wide, ederally controlled power grid.

For the immediate future, conver- on of the Hanford reactor for pow- er generation is intended to accomplish two vital objectives: establish a steam plant precedent outside the TVA area; and build a power surplus in the Pacific Northwest as leverage for putting across the proposed high voltage Bonneville-California intertie. With this beginning, the door would be opened for more thermal plants, and future transmission links would tie in the already blueprinted Colorado River grid, the Missouri Basin, Southwestern Power Administration, TVA, Southeastern Power Administration, and so on.

Hanford, at this writing, had been floored by a surprisingly wide-margined vote in the House. But it had not been counted out altogether for this year.

Close observers of Hanford's background showed little wonder that the political fight for the project became uncommonly vicious just prior to the House vote. Leading proponents, in an attempt to scare off private utility opposition and at the same time smokescreen the real issues, launched an all-out attack on the industry from the Senate and House floors. Among the blackmail-sounding warnings were threats of a congressional investigation of industry lobbying, and withdrawal of federal aid to the civilian reactor program. Interior Secretary Udall chimed in with a blast at the "obstructionism of the powerful Eastern private power lobby."

Following the House action, angry Hanford supporters proposed a program for government recapture of private hydroelectric projects as their licenses expire. They warned that "If the government is going to be stopped short every time a new science approaches practical application, then perhaps we had better start looking at opportunities to undergird our security by recapturing some of the old-fashioned means of (energy) production."

An interesting thing about all these goings-on is that, while the private power industry is being lambasted for Hanford's defeat in the House, the coal people are taking the credit for it. Pro-Hanford forces had won an earlier vote in the Senate by promising a $5-million coal research program, and approval of the coal-supported national fuels policy study. But coal's big guns in both mine-owner and union camps soon shook this bait and lined up solidly against Hanford in the House. One United Mine Workers journal carried the result in a story headlined: "UMWA Successful in Fight to Block Hanford A-Plant."

Another significant development in the background was the secret meeting, reported to have been held at Interior Department a week prior to the House vote, between Udall and top-flight representatives of the American Public Power Assn, National Rural Electric Cooperative Assn, and the AFL-CIO. Udall was said to have unveiled a long-range program for government power expansion in keeping with the national grid concept, and to have spotted on the envisioned network the proposed locations for some ten or twelve giant federal reactors — of which Hanford would be the first.

None of the reported participants has denied that the meeting took place, or that the discussion centered on development of a huge federal power system.

Hanford proponents at this writing were making much talk about a possible compromise looking toward the installation of just enough generating capacity to take care of the plutonium plant's own power needs. Such an arrangement would, of of course, be the usual public power foot-in-the-door, and would surely open the way for later installation of additional capacity.

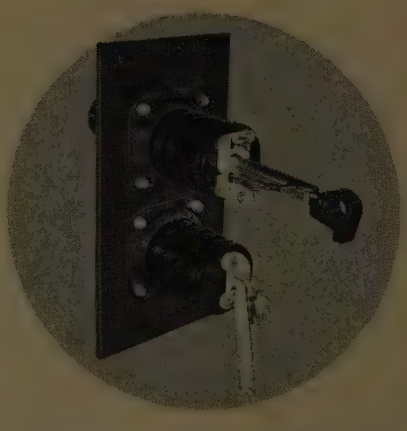
Viewed with one eye on the long-range ambitions of the federal power planners now operating in Washing-

(Continued on page 61)

New Westinghouse Pad-Mounted Transformer for Underground Distribution Systems

Lack of standardization has hampered the development of residential underground distribution—made such systems difficult and expensive to install. For example, Westinghouse has designed more than 300 different variations of pad-mounted transformers—which is costly both to the user and the manufacturer. After several years' study of customer needs, Westinghouse announces the PSP—a complete transforming

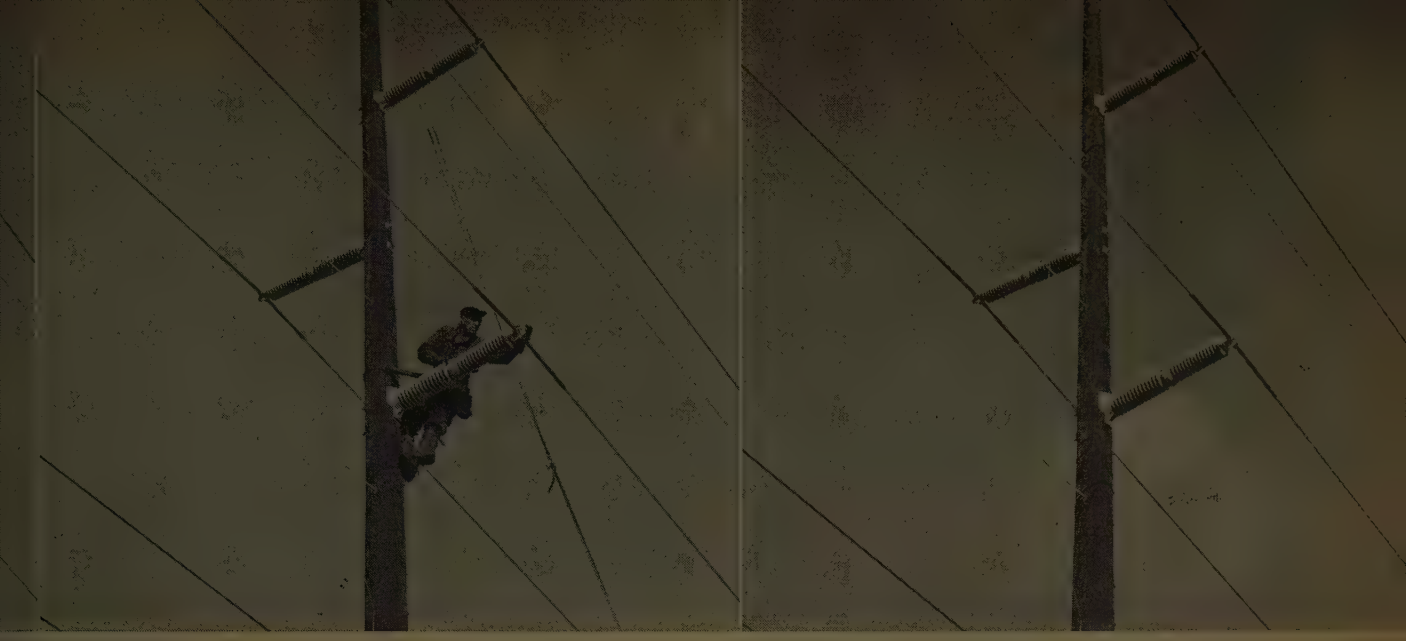
Westinghouse Primary Service Pad-Mounted Transformer, with optional provision for customer service meters. Main cover can be opened only from inside. Transformer compartment is located directly behind HV and LV terminal compartments. Accommodates 10 through 50 kva transformers interchangeably with same compartments. Detachable cover assembly interlocks with terminal and transformer compartments for maximum security and safety.



HV load break air switch—a Westinghouse exclusive—isolates transformer. Switch has visible disconnect blade (shown in open position), will safely interrupt 400-amp load current. Interrupter switch and disconnect are mechanically interlocked.

Built-in fault detector is an exclusive optio al feature. Magnetic pickup type indicat shows location of fault when cabinet closed. Note indicator button at base cabinet in main view above.

J-709



MOUNTED LAPP LINE POSTS FOR 115-138 kv TRANSMISSION

Armless construction using horizontally-mounted Lapp Line Posts is now a standard practice with many utility companies for transmission and sub-transmission lines at voltages up through 69 kv.

Now the same advantages of such armless construction are available for transmission at 115 kv and 138 kv. The externally-attached integral gain base is a malleable iron casting which provides maximum contact to pole. Insulator is bolted directly to the pole by bolts at top and bottom of the base. The structure is easily assembled on the ground before erection, as shown in the picture sequence below. Clamp-top head with trunnion clamp makes for easy one-man assembly to conductor.

Units of two strength classes are available, each in three lengths, which match (and, in some important characteristics, exceed) flashover values for strings of 6, 7, and 8 suspension insulators.

Write for complete data. Lapp Insulator Co., Inc., Le Roy, N. Y.

ow voltage look" for use in built-up areas

Lapp

ECONOMIC OUTLOOK

BY A. C. FARMER
ECONOMIC CONSULTANT

The Report Of the Commission On Money and Credit -- Part I

Modern economics includes no basic fundamentals to which all economists subscribe. No laws or principles universally are recognized as applying to economics as is the case, for example, with subjects like music and mathematics.

This is not to say that basic laws of economics and basic principles of economics do not exist and do not operate in the American economy—merely that they are not recognized as such and have no general or universal acceptance today by large numbers of accredited economic experts. The proof of this statement clearly is demonstrated in the report of the Commission of Money and Credit under consideration.

The Commission on Money and Credit, established in 1957 by the Board of Trustees of the Committee for Economic Development to study the public and private financial institutions of the United States, published a full report of its study findings in July, 1961.

In the Introduction and statement of objectives, the Chairman of the Commission, Frazer B. Wilde, makes in part the following explanation:

"The Commission on Money and Credit was charged with making a comprehensive study of the public and private monetary and financial institutions of the United States.

"From the beginning, three major objectives, which are clearly the primary aims of monetary, credit and fiscal policies, stood foremost in its deliberations. These are — an adequate rate of economic growth, sustained high levels of production and employment, and reasonable stability of prices."

Many economists will not agree that the three "National Goals" cited above "can be achieved simultaneously and that they are fundamentally compatible if we do not expect the impossible of each."

It is of great interest, therefore, at this point to find that the Commission's vice chairman, H. Christian Sonne, has included a memorandum of dissent which in part reads as follows:

"My criticism is directly mainly at the Commission's failure to deal adequately with the past and especially with the future.

"As regards the past. I fail to see how a Commis sion on Money and Credit can ignore the basic ques tion of what money and other circulating media i the U.S.A. should be based on. This question seem the more important during the present period whe the public is worried about 'inflation' or the shrinkin value of the dollar.

"When discussing 'The Causes of Inflation' in Chap ter Two (p. 15, ff.) a distinction is made between pric increases resulting from demand-pull and those re sulting from demand-shift and cost-push. But all w are told is that if the latter are dominant, certai difficulties arise, and so forth. No answer is given t this national question: Is perhaps something wron with the methods by which our circulating media o approximately $140-billion have been created? Hav these media the proper underlying values in good and services?

"The public is entitled to be told whether the Com mission concludes — based on its concept of the mean ing of money — that recent price rises have or hav not been influenced by the quality or quantity of ou circulating media. The report should also deal full with the fundamental rules and regulations governin the commercial banks and with the operation o the Federal Reserve System influencing our mone supply.

"A clear analysis of the events affecting monetar policy from 1914 to 1940, coupled with the Commis sion's admirable analysis of such events in the recen past and the present, should provide an excellen basis for considering — The monetary problems tha seem likely to be important in the future."

The comments of Mr. Sonne appear fully justifie in the opinion of the writer, particularly as the event in the past do provide a clear demonstration of "The monetary problems that seem likely to be importan in the future." This will be covered in Part II, to b in next month's issue.

Footnote—In the field of politics in America the old party classifications of Republican and Democrat largely have been superseded in practice by the new classifications of liberal and conservative. Regardless of party label, liberals and conservatives tend to vote together whenever the issues clearly are defined as basically supporting either liberal or conservative policies.

Years ago Mr. Dooley made his famous remark that "the Supreme Court reads the election returns." This has been proved to be true many times since, and it is not surprising that in like manner an attempt has been made to adjust modern economic theory to conform with the "liberal" trend in modern American political life.

Footnote—An important basic economic law that operates to day in the American economy is to be found in the equation—

$$\frac{\text{Purchasing Power (Money)}}{\text{Production of Goods and Services}} \text{ equals Price Level}$$

Today the price level has a floor below which sales ar unprofitable. This leads to a continuous struggle to reduc costs by more mechanization—a large part of the gains bein absorbed in wage increases.

The equation also shows that by monetary expansion (infla tion) purchasing power can increase the production of good and services. It also demonstrates why the expansion of credi is so attractive, and why attempts to slow up credit expansion meet with such little success, industry-wise or politically.

NUCLEAR NEWS

SADA FUEL TEST FACILITY to demonstrate the techni-ality and improved economics of nuclear superheat under construction as part of the research program f the N. Y. state electric utility companies. The utility roup moved quickly (within one week) after receiv-ng AEC approval of construction plans. Comments SADA Pres. Ernest R. Acker: "We look to the SADA program to guide us in the development of a uclear system capable of producing steam with the igh temperatures demanded by today's high-speed, igh-efficiency turbines."

HUTDOWN FOR REFUELING, SHIPPINGPORT had chalked p the equivalent of 13,706 full power hours in oper-ting on the Duquesne Light Co. system since 1957. When output of the Shippingport reactor is boosted to he equivalent of 150,000-kw (as authorized by Con-ress and financed with a $9-million appropriation), he redesigned reactor core (presently under con-truction at the Bettis Laboratory operated for the AEC by Westinghouse) can be tested at more than wice the initial output of the Shippingport core.

VANTED: LICENSEE'S CHOICE—Counsel for Yankee Atomic Elect. Co., D. G. Allen, believes that AEC egulations for licensing reactor operators should ermit a choice between one of two approaches—to nclude the hazards summary report in technical pecifications, or, to cover all important features of lesign and operating procedures as well as a full set f operating limits in more extensive technical speci-ications—thus avoiding incorporation of the entire letail of the hazards summary report. (The AEC roposed amendments to its licensing regulations last April, invited comments, has been reviewing the eactions of "generally satisfied" critics.)

AFEGUARDS ANALYSIS OF SAXTON Nuclear Experi-nental Program, subject of a public hearing on the SNEC's application for a provisional operating license earlier this month, was made available to the public everal weeks before the hearing. In it the Advisory Committee on Reactor Safeguards noted the staff onclusion that "there is reasonable assurance that he Saxton reactor can be operated as proposed (up o 20-megawatts thermal) without undue hazard to he health and safety of the public."

TUDY PROPOSAL BY EAST CENTRAL Nuclear Group has een under evaluation by the AEC. Development roject of the Florida group was cancelled in June, argely due to unresolved problems on the proposed se of beryllium cladding in the natural uranium, eavy water reactor under study.

RGANIC-COOLED, MODERATED REACTOR on which he AEC last April had four more-or-less definite proposals in response to an invitation under the Commission's Power Reactor Demonstration Program was of interest only to the Grand River Dam Authority (an agency of the state of Oklahoma) as of last month. GRDA submitted a proposal for cooperating in building the 50-mw unit, which might be built and operated by the AEC itself, should this proposal be unacceptable.

REALIGNMENT OF AEC'S REACTOR Development Division, announced recently, continues U. M. Staebler as the top man for power applications. Formerly senior assistant director, Dr. Staebler is now Associate Director for Power Applications.

PG&E 325-MW PLANT POWER COST estimate of 5.62-mills/kwh was challenged by Sen. Clinton Anderson on the Senate floor, where he reported that the AEC's estimate was 6.76-mills/kwh. The Joint Committee, in explaining the calculations, pointed out the analysis is based on a minimum of data and that total capacity costs may not be firm.

SODIUM-COOLED, GRAPHITE-MODERATED reactor plant that "could initially generate power at an estimated 6.2-mills/kwh" has been offered to the electric utility industry in a 360-mw rating. Atomics International Div. of No. Amer. Aviation promises "substantial fuel cycle cost reduction during plant operating life." Construction could be complete within 40 months after arriving at a final design.

First refueled in 1959, reactor at Shippingport was recently shut down again for fuel element replacement (see above). Control rods and instrument cables are visible in this view, after dome was removed. Actual work was done under water at the pioneer installation on the Duquesne Light Co. system.

NEW Techniques and NEW Equipment make line maintenance SAFER, SIMPLER, MORE PRODUCTIVE

By O. G. "Andy" Anderson, Product Manager

Men responsible for power line construction and maintenance are constantly looking for greater SAFETY, SIMPLICITY and PRODUCTIVITY.

The development of insulated booms and platforms or buckets provides a new method of reaching these objectives.

In studying the possibilities for this new aid to maintenance work and at the same time keeping Safety in mind as we have always done in developing hot line maintenance methods, we have reached this definite conclusion. Where insulated platforms can be maneuvered into position, the safest practice is to combine them with insulated tools. That's why Chance demonstrators, who have accumulated years of service with the elite of the pole climbing fraternity, join the "bucket brigade" when the job justifies the means . . . as when they combined hot line tools and power tools with insulated booms and buckets for the switch installation shown above, at right.

This method allows hot line maintenance crews to work with only one set of safety rules. There is no need to decide which safety rules to follow and crews are not confronted with the risk and confusion of alternating the long standing habit of working at ground potential with an entirely new procedure of working at line potential.

The A. B. Chance Company has teamed up with the Pitman Manufacturing Company, to work with your supervisors and line crews in developing the most efficient procedures for this combination of tools and equipment.

A. B. CHANCE CO. CENTRALIA, MISSOURI

A. B. Chance Co. of Canada, Ltd., Toronto CH61-25

Chance demonstrators have the job of helping Chance customers get the highest productivity from their line crews with the greatest simplicity and safety. They, too, continually look for, and help develop better, easier, safer ways to do the many and varied jobs of line maintenance men.

As linemen, with the responsibility of demonstrating new methods to line crews, they never forget the most important word in their vocabulary . . . SAFETY. In their search for better and more productive advances in hot line work, they give first consideration to the safety of the men who must do the work.

Here, demonstrator Don Collins shows a midwestern line crew how to use the new Chance power compression tool. Line crews and their supervisors learn dozens of special techniques from these demonstrators. The entire Chance demonstrator "team" is shown at right.

INSULATED BOOM AND BUCKET USED WITH INSULATED TOOLS. A good example of this combination is shown above where hot sticks were attached to the pole to support a jumper, while insulated power tools and hand tools were used from an insulated bucket to "cut-in" a three-phase switch. This job was completed in record time without service interruption and without climbing the pole.

HOT STICK HANDLING OF BUNDLED CONDUCTOR. In the photo at top right, demonstrators and utility personnel use specially designed Chance Hot Sticks for handling energized bundled conductors while changing insulator strings on a 460 KV system. This method of insulator replacement has proved highly successful.

HOT STICK TROLLEY DEMONSTRATED. Another job simplification is shown in photo, middle right, where a Chance developed Hot Stick Trolley is used to transfer insulators for replacement on guyed steel H frame structure. This same technique is used on towers or wood H frames to bring insulator strings to an easily accessible position for making unit replacements.

PHASE TESTING DEVICE. A new Chance phasing tester is used, lower photo at right, to demonstrate how to determine correct phasing relationships before joining two circuits together.

Regardless of whether the job can be done from the pole or from an insulated platform, Chance Epoxiglas (glass reinforced resin) tools and insulated power tools help to make hot line maintenance work Safer, Simpler and More Productive.

Don Collins
Centralia, Mo.

Bob Bond
Roy, Utah

Bob Boehmer
Wheaton, Illinois

Bill Shreve
Burlington, N. J.

"Cliff" Bosch
Birmingham, Ala.

Vern Moody
Dallas, Texas

NEW PRODUCT DESIGN

Load-Break Switches

Westinghouse Electric Corp. has announced the availability of two

load-break switches (air break and oil break) for integral assembly with pad-mounted distribution transformers.

Either switch can be used as a load-break switch for removing a transformer from the line or as a sectionalizing switch to remove a high-voltage feeder from service for maintenance.

Both switches can be used on systems up to 14.4 kv, and have a basic impulse level of 95 kv. They have a continuous current rating of 200 amp, and a momentary rating of 10,000 amp asymmetrical. Maximum load break rating at 14.4 is 200 amp.

Circle item #1 on reply card

Circuit Breaker Test Set

A two-section circuit breaker test set now available from **Multi-Amp Electronic Corp.** provides extra flexibility and ease of handling through narrow passages, and in close work areas. The set, rated 2.5 kva, is designed for testing low-voltage power and molded-case circuit breakers. Known as model CB-25-2P, it complements the company's rated 2.5-kva integral test unit.

The set consists of two separate enclosures with detachable interconnecting cables. One section contains an autotransformer, metering, timing and control circuitry. The other section has a double-wound transformer with output taps for a choice of currents for safe, accurate testing and calibration. A current transformer is included.

Circle item #2 on reply card

Tap Connectors

Penn-Union Electric Corp. announces the completion of a line of Tap Connectors for connecting cable to aluminum or copper buses, spades or contact pads of transformers, switches, or switchgear enclosures.

This line of "LS" and "LSN" single tap and "LD" one-way or two-way eyebolt tap connectors covers the full range of cable sizes from # 10 solid through 2,000 MCM cable, and permits clamping up through a ¾" thick pad or structural member.

The types "LS" and "LSN" have the additional features that permit the mounting of four connectors on a standard four-hole NEMA drilled pad to accommodate cable sizes up through 1,000 MCM cable. The type "LD" double-basket eyebolt terminal is designed with ½" diameter bolts on 1¾" centers which meet two-hole NEMA pad application.

Circle item #3 on reply card

Redesigned Power Transformers

Greater mobility, easier station change-outs and longer service life

are among the advantages of redesigned power transformers announced by **General Electric Co.**

The advantages are the result of product improvements suggested by 32 electric utilities and consulting firms interviewed last year, the company says. The improvements are centered around Preferred Design large substation transformers rated up to 25,000 kva.

Moving is simplified because tank height has been reduced from over 15 ft down to 12 ft and weights have been cut about 10 percent. The lower height means transformers on highway trailers can pass under bridges built to former federal minimum clearances of 14 ft as well as present 16-ft requirements.

Circle item #4 on reply card

Outdoor Current Transformer

A new through-type outdoor current transformer is being announced by the **Sangamo Electric Co.** The type V-150 transformer combines high voltage (15 kv) capabilities with low cost. Because of its two-percent accuracy characteristics, the transformer is suited

or use with system measurement meters and for capacitor switching control instruments. The V-150 is

available in 200:5 and 100:5 ratios. The type V-150 is molded in epoxy and fitted with a porcelain bushing which will handle conductors up to 15/16 inch diameter. The transformer is furnished with five feet of type SO 12/2 secondary lead. The secondary outlet is fitted with a one in. threaded bushing for conduit connections.

Circle item #5 on reply card

Neutral Span Clamp

Known as the type MS, a neutral span clamp developed by **Jasper Blackburn Corp.** doubles as a paral-

el groove connector for aerial cable neutral, and as a dead-ending clamp accommodating up to four service drops.

All four taps need not be made at the time of installation; they may be installed later, independently of existing conditions. The one-piece clamp is cast in high strength aluminum alloy, with galvanized steel hardware.

Circle item #6 on reply card

Pole Bandage-Making Machine

To provide more versatility and

economy in application of pole bandages in ground-line treatment, **Androc Chemical Co.** has developed a pole bandage-making machine it calls "NDKator."

Featured is a front-mounted roll of separator paper which allows field crews to make prepared bandages of exact length required for each pole being treated. Waste from "factory made" pre-prepared bandages, which are usually of standard sizes, is eliminated, the company says.

From the seven-gallon hopper, preservative is spread automatically at ¼ in. thickness between base and separator papers. Saw-tooth cutting bar tears bandage in single, clean operation.

Circle item #7 on reply card

Mastic Connector Cover

A Mylar-backed mastic compound for use in covering electrical connectors has been developed by **A. B. Chance Co.** The pads protect the connection from erosion, dirt accumulation, and chemical attack.

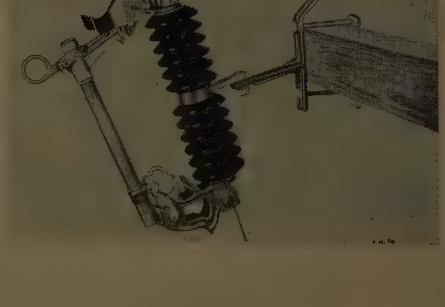
They will also extend inhibitor life and effectively prevent connection external deterioration. The mastic compound is weather resistant and does not become brittle or flow within a temperature range of –50 deg F to 250 deg F.

The Mylar provides an added safeguard against puncture during installation, and provides an electrical insulation level of 1000 volts per mil.

Circle item #8 on reply card

Cutout Arresters

Southern States, Inc. recently announced a new line of cutout arrester combinations consisting of an open type distribution cutout mounted in conjunction with an externally gapped, valve type arrester.



Any one of five Southern States cutouts rated 7.8, 15, or 27 kv may be specified as components of these combinations. Cutouts available are the expendable cap BV-33-F or single-vented SV-33-F; the extra heavy-duty BV-33-G; the BV-33-J or SV-33-J are equipped with hooks for use with a load break tool. Arresters rated 9, 10, 12, 15, or 18 kv are available.

Southern States Cutout Arrester Combinations are supplied for mounting on either cross arms or poles. Each mounting arrangement may be supplied with the arrester mounted vertically or horizontally.

Circle item #9 on reply card

Tap Changing Transformers

A major design advance in **Allis-Chalmers** load tap changing trans-

formers provides 20-percent savings in size and weight and reduces losses 15-percent and more, the company says. The new equipment is available in a complete line especially for application on autotransformers 50,000 kva and larger through the extra high voltage range.

Installation cost is low since the tap changers are shipped completely assembled and installed. Line bushings are standard and replacements are readily available should damage occur. The tap changers, says the company, are highly reliable, and are an advanced design based on 37 years of Allis-Chalmers experience in load tap changing. Maintenance is simplified because all current interrupting components are easily accessible.

Circle item #10 on reply card

SUPPLY FACILITIES

Babcock & Wilcox Company Occupies New Division Sales Offices

The Babcock & Wilcox Company has announced changes of address for its Philadelphia, Pa. and Los Angeles, Calif. Tubular Products division sales offices.

In Philadelphia, the new quarters occupy Suites 1919-21, The Packard Building, 15th and Chestnut Streets. In Los Angeles, the offices have been moved from 1111 Wilshire Boulevard, L. A., to 94 South Los Robles Building, Pasadena.

The moves were made to provide space for integrated data processing equipment which links the sales offices to the Tubular Products division headquarters in Beaver Falls, Pa.

Electric Service Systems Acquires Pole-Top Switch Line

In a move designed to extend the company's range of electrical equipment for rural use, Electric Service Systems has acquired from Braham Industries, Inc. a line of pole-top switch-boxes which had been marketed by the Bulldog Electrical Products Division of ITE Circuit Braker Company. Terms of the transaction were not disclosed.

The pole-top disconnect will be manufactured in Electric Service Systems' Minneapolis plant. It will be marketed under the ESS label through direct sales to Rural Power Companies.

SKF Uses Radioactivity In Bearing Research

Radioactivity shows metal particle transfer from a bearing roller to race, say SKF Industries' researchers. Preliminary radioisotope studies have shown the existence of metal transfer between irradiated roller and non-irradiated race by direct surface contact or through radioactive wear particles carried in the lubricant of a bearing, according to the company.

Among bearing-user benefits of the study—believed to be the first completed of its type in the industry—are the insurance of proper pressure distribution to add bearing life, the ability now to pinpoint the best lubricant for specific conditions, and the technique's usefulness in studying surface finishes.

Successful use of the radioactive tracer technique had to be specially developed to permit measurement of the transferred metal in quantities as minute as 10^{-9} grams/mm^2.

Phelps Dodge Joins In Developing New Fabricating Plant in Argentina

The Phelps Dodge Corp. recently signed a contract to join other interests in the establishment of a major copper and brass fabricating company in Argentina.

The contract, subject to approval by the Argentine government is the result of negotiations based upon competitive bids solicited by Fabricaciones Militares on a world wide basis. The bid invitations called for a joint undertaking of private and government capital to develop a copper and brass fabricating plant utilizing certain existing machinery and equipment, and buildings under construction.

Westinghouse Le Roi Division Moves to Sidney, Ohio

Westinghouse Air Brake Co. has announced that its Le Roi Division operations in Cleveland will move to Sidney, Ohio, where it will be consolidated into the Division's Sidney plant. The move, which will be accomplished in several gradual steps, will be completed by Spring, 1962.

In January, 1960, Le Roi moved its manufacturing, sales, administration and engineering functions from West Allis, Wis., and Green-

wich, Ohio, to Sidney. Simultaneously, machining operations for all its plants were transferred to Cleveland.

G. E. Starts New Financing Office At Cleveland

A new regional Commercial & Industrial sales financing office has just been established at Cleveland, Ohio, by General Electric Credit Corp. (GECC). The east central regional office will serve the states of Ohio, Michigan, Indiana, Kentucky, West Virginia, Western New York and Western Pennsylvania.

Tungsten-Rhenium Alloys Produced in Wire, Strip Form

Development of new, improved metallurgical processing techniques which permit production of ultra high temperature tungsten-rhenium refractory metal alloys in an expanded range of wire and strip sizes has been announced by Hoskins Mfg. Co., producer of electrical resistance, resistor, thermoelectric and mechanical purpose materials.

Since installation of special equipment required for its new processing methods, Hoskins has produced a tungsten-26-percent rhenium alloy in wire sizes as fine as .0005 in. diameter, and in continuous lengths of over 2000 ft. Short lengths of strip of the same composition have been produced by the new process in widths up to four in. and in thicknesses down to .005 in.

Multi-Amp Completes Move To Larger Quarters

Multi-Amp Electronic Corp., manufacturers of electric test equipment for protective devices, has completed its move to new, larger quarters at 61 Myrtle Street, Cranford, N. J. The company was previously located at 465 Lehigh Avenue, Union, N. J.

To meet its immediate space needs, Multi-Amp has constructed a modern 15,400 sq ft building on a two-acre site. It is approximately five times larger than the company's previous manufacturing facilities. Plans are also included to double the present manufacturing area of the new company-owned property.

MEN OF POWER

Neill Richards, secretary-treasurer and a director of Kansas Gas and Electric Company, has been elected a vice president of the company.

Richards

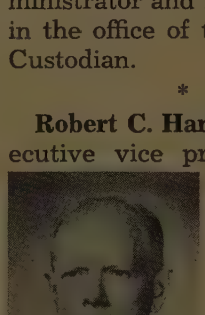
He was elected by the company's board of directors at a recent meeting in Wichita.

A veteran of more than four decades in the public utility industry, he began his career in 1919 with the Interstate Power Company, and later became its treasurer. He has been assistant treasurer of Utilities Power and Light Corp. in Chicago.

During World War II he left the utility field briefly to become an administrator and business consultant in the office of the Alien Property Custodian.

* * *

Robert C. Harnden, formerly executive vice president, has been named president and general manager of Chapman Chemical Company, manufacturer and distributor of wood preservative, agricultural and industrial chemicals. He succeeds **A. Dale Chapman,** founder of the 28-year-old company, who moves up to chairman of the board. Mr. Chapman also will direct research and new product development for the firm.



Harnden

Mr. Harnden joined Chapman Chemical Company in 1946 to handle research and plant operations. He organized the agricultural chemicals division in 1948. He was manager of the Dowicide sales division immediately before joining Chapman.

* * *

O. J. Toulouse has been named director of employee relations and safety at Sierra Pacific Power Company. His experience in the utility field includes nine years in personnel administration with Iowa Power and Light where he has been a division manager.

* * *

Howard H. Callaway, executive director of Ida Cason Callaway Gardens at Pine Mountain, was elected to the board of directors of the Georgia Power Company at a recent board meeting. He is also chairman of the education committee of the Board of Regents of the University System of Georgia; vice president of the Georgia State Chamber of Commerce and the National Recreation Association, and trustee of the National Safety Council.

* * *

S. E. Ratcliffe, Virginia Electric and Power Company treasurer, has been elected vice president. He will retain his position as treasurer. **George F. Duborg,** Blue Ridge District manager, was elevated to vice president of the company's Western Division with headquarters at Charlottesville. He will replace **Ray C. Hopkins** who is retiring this month.

* * *

Luther S. Singley has been named to the newly created post of administrative assistant, Office of the President, at West Penn Power Company's general office in Greensburg.

In this capacity he will coordinate the various administrative routines in the office of the president.

* * *

Homer T. McCarthy has been appointed power engineer for West Penn at its Greensburg general office. He started with the company as a plant staff engineer at Springdale power station. Three years later he transferred to Milesburg power station, then in 1953 became a results engineer at Mitchel power station. He moved to the general office the following year as assistant to the chief results engi

eer, and in 1956 was named re-ults engineer.

* * *

John F. Hippen has been ap-ointed Western Region manager or General Electric's Residential Iarket Development Operation RMDO). He succeeds **Frank M. 'alge** who has retired from G. E. fter 35 years of service. Mr. Hip-en will operate from RMDO re-ional headquarters in San Fran-isco.

Justin Neuhoff recently was ap-ointed manager-engineering for ;eneral Electric's high voltage witchgear department, Philadel-hia.

* * *

Potomac Edison Company has nnounced the following advance-ients:

J. Malcolm McCardell has been lected assistant secretary and as-istant treasurer. **Charles Morri-on,** formerly manager, Planning nd Relaying, has been appointed ianager of a new department—nown as the Controls Department -which will combine the metering, elaying and communications func-ions. **Marc A. Jansen,** formerly re-ay engineer, has been appointed ianager, Enginering Planning and Research.

* * *

Allis-Chalmers Power Equip-ient Division has announced the ppointment of **Gordon W. Clothier**

Clothier

Peterson

o the new post of manager of ransformer planning. Since De-ember 1956 he has been manager f the motor and generator depart-ient at the West Allis Works. Prior o that he was engineer-in-charge f transformer sales, later becom-ng manager of the transformer de-artment.

Succeeding Mr. Clothier as man-ger of the motor and generator de-artment is **Walter L. Peterson,** ormer assistant manager of the iotor and generator department.

Edison W. Lytle has been named Northeastern Sales Division manager by RT&E Corp., distribution transformer manufacturers. **Charles H. Kyle** will succeed Mr. Lytle as RT&E sales representative in central Ohio, western New York, Pennsylvania, and West Virginia.

* * *

Harry L. Niederauer has been named manager of marketing services of the Westinghouse lamp division. He was advertising and sales promotion manager of the Westinghouse lamp division from 1943 to 1954.

In his new position, he will be responsible for a wide range of marketing activities and services including sales promotion, advertising, personnel development and various selling support activities. He will work closely with key members of the headquarters marketing group, as well as the field selling force.

* * *

William H. Honaker, Jr. has been appointed regional industrial sales manager for Reynolds Metals Company in the 10-state central sales region.

He will be responsible for sales of Reynolds aluminum to the transportation, electrical, appliance, chemical and other industries, as well as to the firm's many industrial distributors here. He joined Reynolds in 1941 in the metallurgical division.

* * *

Phelps Dodge Copper Products Corporation has announced the appointment of **Robert A. Webb** as manager of utility sales. He joined Phelps Dodge in 1946 as an engineer in the production department of the Wire and Cable Division. Later, he was appointed field installation engineer, supervising all types of high voltage cable systems.

Most recently he was transferred to utility sales as a power cable sales engineer, and has been in charge of all utility sales engineering for high voltage cable.

INDUSTRY STORY—*from p. 34*

with local company tie-in.

Companies have also requested a folder based on the chart series, suitable for use as an enclosure with bills, dividend checks and other mailings, as well as for widespread public distribution in other ways.

The presentation booklet underscores these "Plans for the Future": by 1980, a peak load of 428.5-million kw and a capability of 492.6-million kw, an investment of $168-billion, and annual construction expenditures at the rate of $12-billion (for the investor-owned segment of the total industry).

The presentation sums up "the industry story" this way:

1. America now has an ample, efficient power supply system with adequate reserves—three times the capacity of Russia.

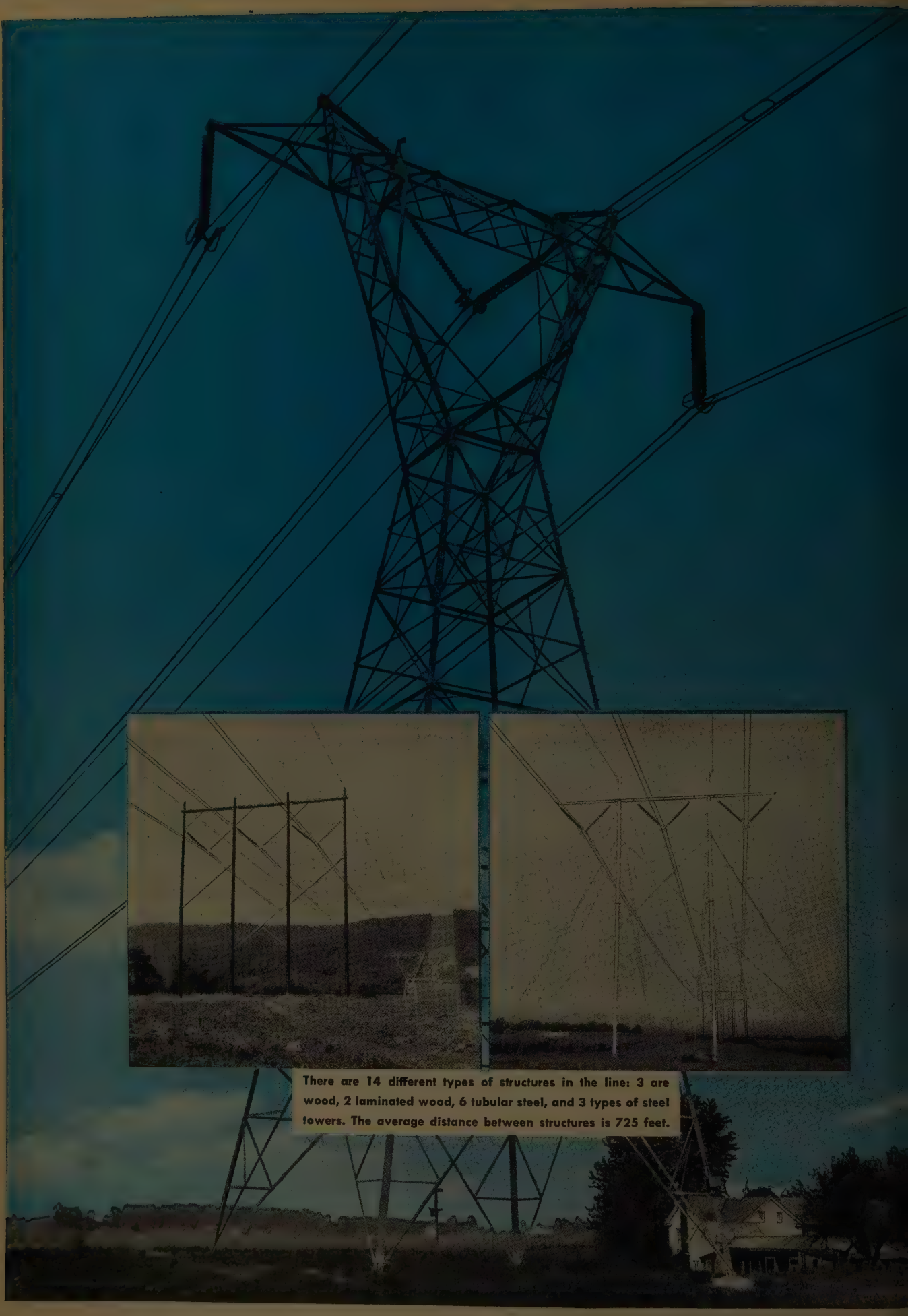
2. Eighty-percent of this power is supplied by 400 investor-owned light and power companies.

3. The companies have plans for serving America's future power needs with financing in the free market.

HANFORD—*from page 37*

ton, the Hanford project—regardless of what happens to it this year—is nothing less than a Pandora's box as far as the investor-owned power industry is concerned. And the same goes for all who are opposed to the widening area of socialism in this country.

Editor's note: After Editor Elliott's discussion of the Hanford situation was prepared, the Senate approved a $58-million appropriation to construct one 400,000-kw generating unit at the AEC installation in Washington. In the compromise bill, cleared through a Senate-House conference committee by a 6 to 2 vote, a provision required that energy generated by this single unit must be used exclusively by the AEC facility on the Hanford site. Voicing disapproval of the compromise plan, Rep. James E. Van Zandt (R.-Pa.) said: "The Senate is asking us to approve an even more prosperous plan than the original, in that taxpayers would be forced to underwrite a plant whose per-kilowatt of installed capacity would cost about 22-percent more than called for under the previous proposal." As the bill was sent to the House, Rep. Van Zandt called on his fellow Congressmen to "rise in even greater force to announce that it will not tolerate such complete disregard of the need for economy at a time when we are already involved in the most expensive defense effort in all history."



There are 14 different types of structures in the line: 3 are wood, 2 laminated wood, 6 tubular steel, and 3 types of steel towers. The average distance between structures is 725 feet.

AMERICA'S "BIG-VOLT" LINE protected by ALUMOWELD OVERHEAD GROUND WIRE

Like the famed "Big Inch" in the oil industry, Pennsylvania Electric Company's "Big Volt," its new 460-KV transmission line, represents a bold step forward in supplying the growing energy needs of America.

To protect the highest voltage operational line in America from lightning and transient currents, Penelec is using Alumoweld Overhead Ground Wire. This dependable, low-cost shield wire has three times the electrical conductance of steel, is just as strong and weighs 18% less. It has the same long life as solid aluminum.

Alumoweld is the result of the first successful cladding of a *thick* layer of pure aluminum over a high-strength steel core. The concentric aluminum covering comprises 25% of the cross-sectional area of each wire. Its high strength-to-weight ratio—higher than any other overhead ground wire—permits stringing with greater mid-span clearance to provide maximum lightning protection. Alumoweld's excellent conductivity assures reliable operation of protective relays and effectively discharges transient currents to ground.

Order Alumoweld Overhead Ground Wire and get Low-Cost, Long-Life Protection for your transmission lines.

For more complete Alumoweld data send for Engineering Bulletin E.D. 3000.

A seven-strand Alumoweld Overhead Ground Wire (7 No. 6 Awg wires), approximately ½-inch in diameter with a breaking strength of over 22,700 pounds, is used to protect the highest voltage transmission line in America.

ALUMOWELD®

COPPERWELD STEEL COMPANY

WIRE AND CABLE DIVISION Glassport, Pa.

For Export: COPPERWELD STEEL INTERNATIONAL COMPANY, New York

Canadian Distributor: NORTHERN ELECTRIC COMPANY LIMITED

LETTERS FROM READERS

Dear Editor:

I am prompted to comment on your August 1st Electric Light & Power editorial on the application of the bare-handed maintenance technique to energized conductors because it contains an inference, at least, that this technique cannot be used safely at all on distribution circuits.

We are continually finding more ways to utilize this practice, which was developed on the American Electric Power System, and naturally we do not wish to see any unsubstantiated criticism that would discourage others from doing the investigative work necessary to take full advantage of the very significant improvements in safety and cost and time savings that this technique holds forth in our day-to-day operations.

As a utility organization, we are certainly as safety-conscious as others and we never accept a compromise in safety for the sake of savings in operating expenses. For us, any equipment, installation or maintenance procedure or work method that is unsafe or impractical is taboo unless or until ways are found to make it safe and practical. Frequently these ways can be found; this certainly has been our experience with bare-handed work on energized conductors.

We recognize that the bare-handed approach is not applicable to all types of maintenance or reconstruction work, nor in all specific locations on power lines and in substations, but circuit voltage, be it classified as transmission or distribution, is not the criterion that determines its applicability. Our investigative work to date has been concentrated mainly on circuits ranging in voltage from 23 to 345 kv, inclusive, principally because these higher voltage circuits and stations appear to offer the best opportunity for taking immediate advantage of the inherent time and cost savings, but we see no particular difficulty in using this technique safely and advantageously on many tasks to be done on our 4 and 12 kv distribution circuits, particularly where underlying secondary circuits and foliage do not present insurmountable problems.

As a matter of fact, we have used and are using this new technique on distribution circuits in some of our service areas. Where the secondaries, the neutrals, or the other phase wires are too close to the conductor to be worked on, the same protective equipment presently used to maintain safety barriers for linemen when using rubber gloves and hot sticks can also be used to assure safe working conditions for bare-handed work. Innovations have been developed to make bare-handed distribution work as safe and in some cases, even safer, than conventional hot-line procedures.

The interest shown throughout the country in this new technique since it was first announced has been astounding. The more one works with it, the more ways one finds for using it to advantage. We have found that line maintenance which has been deferred, sometimes much too long, because the circuits could not be de-energized, can now be carried out without delay. And such operations contribute not only to the safety of the men doing the work but to the safety of those using the electric service.

Very truly yours,
C. P. Zimmerman
Chief Electrical Engineer
American Electric Power
Service Corp.

Dear Editor:

All of us at ICFA are truly delighted with your splendid editorial support [September 15 ELECTRIC LIGHT AND POWER, Page 66] of our efforts to tell our story to the utilities industry . . .

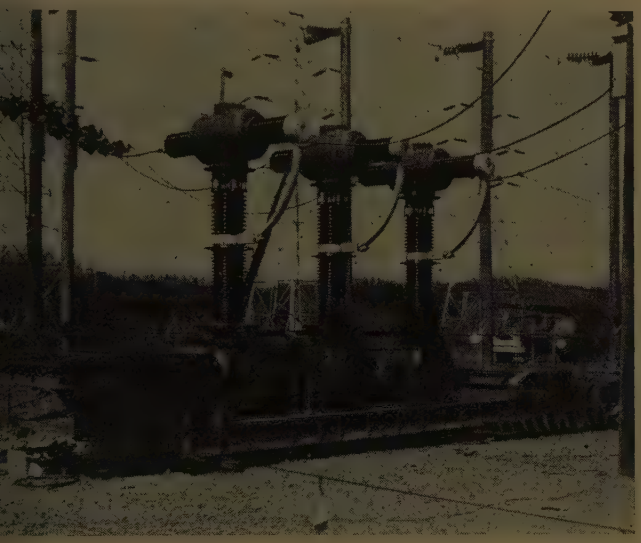
Many thanks for your strong support of the independent colleges.

Sincerely,
Susan McMahon,
Independent College Fund of America, Inc.

G. E. Air-Blast Circuit Breaker Stands Grueling Two-Cycle Interruption Test

A 138-kv General Electric air-blast breaker has ested unbolted on a flat bed truck while interrupt-ng a 40,000-amp fault in less than two cycles at ecent American Electric Power System field tests.

According to engineers conducting the tests, a omparable oil circuit breaker under the same test onditions would require a heavy concrete founda-ion and tie-down bolts to restrain the breaker luring the resulting impact.



New Company To Develop Telemetering Equipment

McClure Kelley, chairman of the board of Bald-vin-Lima-Hamilton Corp. Philadelphia, Pa., and Alfred Lewison, president of Industrial Process En-gineers, Newark, N. J., recently announced their ffiliation through a jointly-owned company named Transitel International Corp.

The new company will develop and manufacture elemetering equipment and systems for industrial pplications; automatic reading of domestic electric, vater and gas meters; and industrial meter reading s an adjunct to automatic load dispatching in elec-ric and gas company operation.

Named as president of the new company is Chris-opher T. Kastner, formerly manager of manufac-uring for the power transformer department of the General Electric Company. Frederick E. Baker, ormerly of B-L-H, has been elected vice president, ecretary-treasurer.

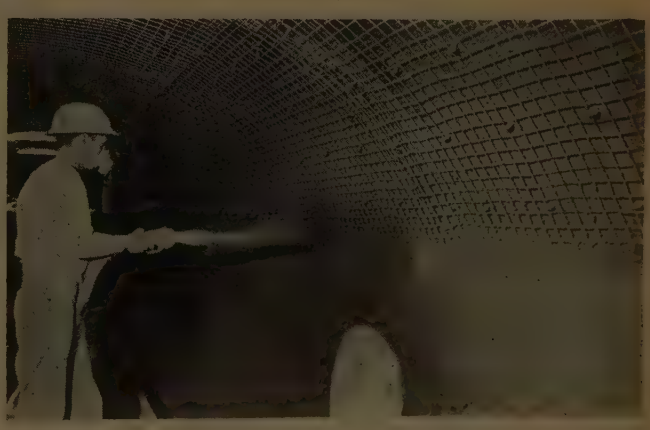
New Methods Cut Turbine-Generator Installation Manhours Up to One-Third

New techniques using precision optical tooling and the latest in turbine-generator test facilities, have been combined to cut unit installation man-hour costs up to 34-percent, according to Allis-Chalmers.

Steam chest, main stop valves, reheat control valves, oil tank assembly, and generator coolant and scav-enging equipment can be completely tested as sepa-rate components and installed at the power station before major turbine and generator assemblies are delivered.

High-Strength Castable Refractory Has Low Gunning Rebound

A new high-strength castable refractory has been developed by The Babcock & Wilcox Company, Refractories Division, for pneumatic gun placement with low rebound loss and minimum dusting. Placed by wet or dry gun methods, the new B&W Kaogun-HS castable produces a high strength monolithic body with outstanding abrasion resistance and excel-lent resistance to thermal shock.



STOP SHOCK! . . .

(Continued from page 33)

Colored slides depicting safe and unsafe conditions are taken during this work observation and developed into strip films with descriptive narratives. As these films are made for the exclusive use of each company, they depict only conditions, work, personnel and construction of the company involved. They are used as a basis for safety meetings over the entire company.

The results in terms of preventing accidents with all attendant liabilities for company and workers are tremendous. The films graphically demonstrate to the employee conditions and practices in his *own* company. Areas where employees are doing a good job are pointed up as well as those where training and instruction is needed. It is just as important to assure men that what they are doing is correct as it is to point up their deficiencies.

In order to gain the cooperation of employees, no sneak pictures are taken. The foremen are told in advance what to expect. During work breaks the entire crew is informed of the pictures that were taken on their job and given the reasons for taking the pictures. In every instance, the men are grateful and happy to learn how to play it safe.

The film program is also a visual report to management. As it frequently shows employees in unsafe positions or employing unsafe methods it becomes an "investigation" report *before* an accident occurs. By viewing these films each employee is better prepared to avoid similar unsafe methods when confronted with comparable work situations. Thus the entire company benefits by "investigating" accidents *before* they happen. Best of all the "victim" and his family are spared the agony of the actual accident.

Safety in a company is not merely a necessary burden of employment practice. It should be the pride of management. A good safety record is a constant, positive reminder to the employee, the community and the general public that management has the employees' interest at heart. Employee relations are improved not by words but by actions. Public relations are improved not by propaganda, but by company policy.

CALENDAR OF EVENTS

Oct. 2-3—Iowa Utilities Management Conference, Hotel Ft. Des Moines, Des Moines, Ia.

Oct. 2-3 — Tennessee Valley Public Power Association Power Use Section Meeting, Hotel Peabody, Memphis, Tenn.

Oct. 3-5—Lighting Progress Exposition, Hollywood Palladium, Los Angeles, Calif.

Oct. 4-6—26th Annual International Association of Electrical League Conference, The President Hotel, Atlantic City, N. J.

Oct. 4-6—52nd Annual Indiana Electric Association Convention, French Lick-Sheraton Hotel, French Lick, Ind.

Oct. 5-6 — NPPA Accounting and Finance Section Workshop, Snohomish County PUD Auditorium, Everette, Wash.

Oct. 5-7 — ASME-AIME 24th Annual Joint Solid Fuels Conference, Dinkler-Tutwiler Hotel, Birmingham, Ala.

Oct. 9-10—PEA System Planning Committee Meeting, Mountain View Hotel, Greensburg, Pa.

Oct. 12-13—EEI Transmission & Distribution Committee Meeting, Hotel Ft. Des Moines, Des Moines, Ia.

Oct. 12-13—PEA Communications Committee Meeting, Lawrence Hotel, Erie, Pa.

Oct. 15-20—AIEE Fall General Meeting, Statler-Hilton Hotel, Detroit, Michigan.

Oct. 15-20—National Safety Congress, Chicago, Ill.

Oct. 16-18—NELPA Business Development Section, Rate Research Committee and Public Relations & Advertising Committee Meetings, Davenport Hotel, Spokane, Wash.

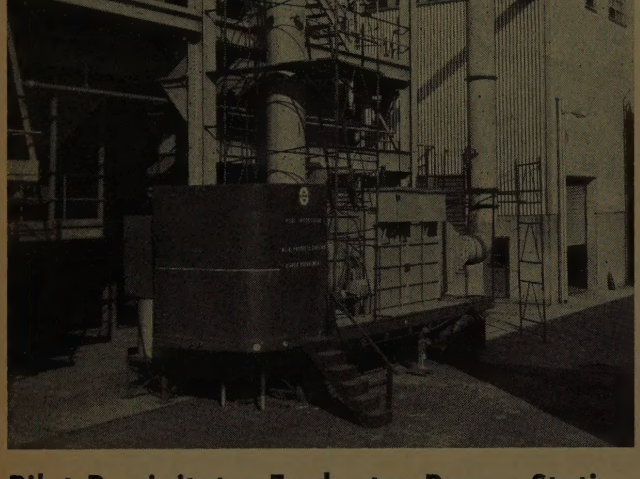
Oct. 18-19—Wisconsin Utilities Association Fall Convention, Schroeder Hotel, Milwaukee, Wisc.

Oct. 26-27 — PCEA Hawaiian Conference, Princess Kaiulani Hotel, Honolulu, Hawaii.

Oct. 26-27—SEE Engineering & Operation Section Conference, Buena Vista Hotel, Biloxi, Miss.

INDEX TO ADVERTISERS

ENGINEERING-OPERATIONS



Pilot Precipitator Evaluates Power Station Precipitator Performance . . .

A mobile pilot precipitator designed and built by the Metal Products Division of Koppers Company, Inc., Baltimore, Md., is being used to obtain certain engineering data on various power station precipitator operations. Initially, the unit will be operated at six carefully selected fly-ash installations which include three different types of boilers burning both eastern and midwestern coals. The combination of coals and boiler types will contribute at least six flue gases having sufficiently different physical and chemical properties to permit a statistical analysis of the effect of the variables.

Based on the premise that the data on which present precipitators are designed will soon be inadequate, Koppers Co. decided that it was essential to accurately evaluate flue gases under actual operating conditions. Also to be investigated is the relation of the physics and chemistry of the flue gas to these operating conditions and to the physics and chemistry of the coal being fired. In the planned program the effect of these factors and how their various interactions influence precipitator performance is to be determined.

The mobile unit shown is located at the Wagner Station of the Baltimore Gas & Electric Co. and is, in reality, a small full-scale electrostatic precipitator having all of the components and characteristics of the larger fly-ash precipitator. It is mounted on a flat-bed trailer which is easily moved to the various locations. Installation can be accomplished in a short time through connections in existing ductwork. The unit will not interfere with the station's operation since the gas is returned to the station's duct after passage through the pilot unit.

Vibrating Principle Used to Keep Wet Sticky Coal Moving . . .

Coal is flowing along smoothly in an experiment being conducted by Union Electric Co. engineers at their Venice Plant. The flow of coal, a perennial problem at power plants is being handled successfully under high head loads by two vibratory feeders and two control devices.

The vibratory feeders are just what their name implies—U-shaped pans, mounted on air springs which vibrate the coal at varying rates. One, mounted below the bunker, feeds coal into a pipe and the other, mounted below a small cushion hopper, feeds it into the pulverizing mill where it is ground into dust for the boiler burners.

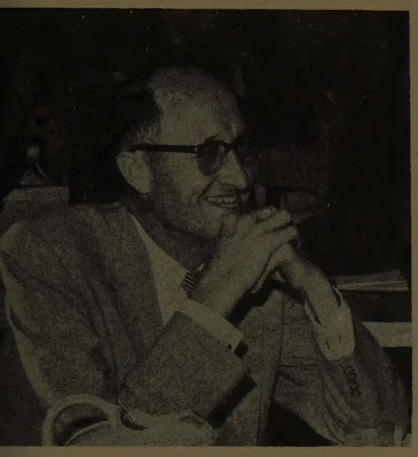
The advantage of the new feeders is that they will keep any type of coal moving automatically, even when it is wet and sticky. Their vibration (which determines the speed at which the coal moves) is controlled by balloon-shaped air springs on which the three-phase motor rests. When more air flows into the springs from the small control box, they inflate and slow down or stop the vibrations; when air pressure is reduced, they deflate and speed up the vibrations. Other springs (called air-rides) insulate the feeder vibration effectively from plant steelwork.

Controlling how much coal moves through the vibrating feeders are two devices: the volumetric, designed by Union Electric engineers, and the nucleonic, which operates something like an electric eye. The volumetric control consists of the small cushion hopper mounted on air-rides filled with hydraulic fluid. Changes in hopper content immediately send a hydraulic signal to the feeder above to speed up or decrease coal flow. The nucleonic device acts as an "emergency brake" on the operation in case of equipment failure. If coal backs up from the hopper to a certain point in the pipe, the "brake" electronically activates relays, which stop the flow of coal from above. The nucleonic control and relays are located outside the pipe, free of wear and corrosion caused by coal.

Check Photoelectric Street Light Controls In Daytime . . .

An Indiana & Michigan Electric Co. lineman has devised a way to check photoelectric street lighting controls in daytime. He fastened a canvas bag on the end of an extended fiberglass fishing rod and he caps the bag over the control units to see if the street lights operate. It's almost like going fishing! Excerpted from April 1961 issue of Edison News employee magazine of The Toledo Edison Company

LIGHT AND POWER LINES



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THE MAGAZINE OF ELECTRIC • UTILITY TECHNOLOGY

Steam-Plant Automation Is A Big Challenge— Off-hand, one might think of computer-controlled steam-plant automation as merely a substitute for the same functions an operator would perform manually. But it is much more than that.

The complexities involved were evidenced in unmistakable fashion at a recent Westinghouse Computer Symposium.

First of all, to obtain the full benefits of automation the complete process must be analyzed for *optimum* operation under computer control.

Then there is the programming, which alone represents a sizeable investment, for it may have to deal with a storage capacity in the computer of as much as 100,000 words, depending upon the degree of automation and plant complexity. In programming the control computer, every detail of plant operation under normal and emergency conditions must be transformed into computer instructions. Included in the computer functions are logging, monitoring, performance computation, start-up and shutdown sequencing, and on-line set-point adjustment.

Design engineers working in this field have found that application studies and evaluations of steam-plant automation are complex, involved, and quite difficult to carry through. Major difficulties are encountered in attempting to get an accurate measure of benefits and improvements and to assign the right dollar evaluation to them.

The first objective of course is to do a "better" control job, but evaluation of "better" control necessitates a sound picture of the shortcomings of *existing* controls. Without a mass of field experience, estimates of the degree of improvement through computer control must be based on engineering studies liberally spiced with engineering judgment and insight.

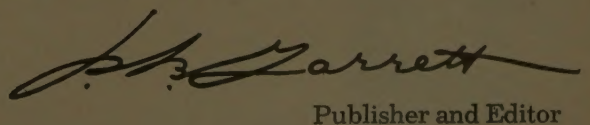
Everyone agrees that improved reliability has economic worth. But measurement of reliability and assignment of a dollar value is certainly less than an exact science.

Since the cost of plant analysis alone amounts to many thousands of dollars, analytical techniques must be refined, to minimize the effort on any one program.

In future plants, today's levels of automation undoubtedly will be extended. These extensions will increasingly emphasize the design of plants specifically for automation.

In the automated system of the future it is envisioned that steam-plant maintenance and supervisory personnel will be on duty during the day to check proper operation, but that at night the plant will operate unattended.

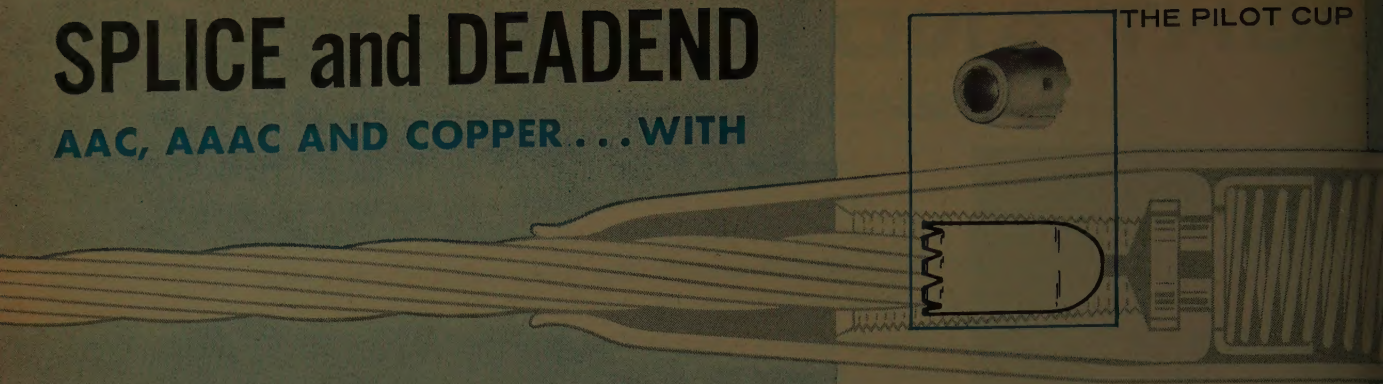
This brief look at the involvements of steam-plant automation gives some indication of its challenges and its potentialities. Progress is already so rapid that it would be difficult for even those working in this field to predict what the future will bring. Of one thing they are certain, all advancements must be consistent with reliable and safe operation.



Publisher and Editor

SPLICE and DEADEND

AAC, AAAC AND COPPER . . . WITH



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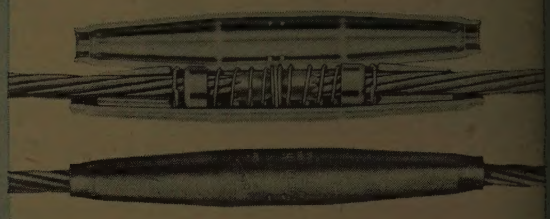

Catalog Number	AAC 7 Strand	AAAC 5005
AL5547	4	5
AL5527	2	3
AL55101	1	2
AL55107	1/0	1
AL55207	2/0	1/0
AL55307	3/0	2/0
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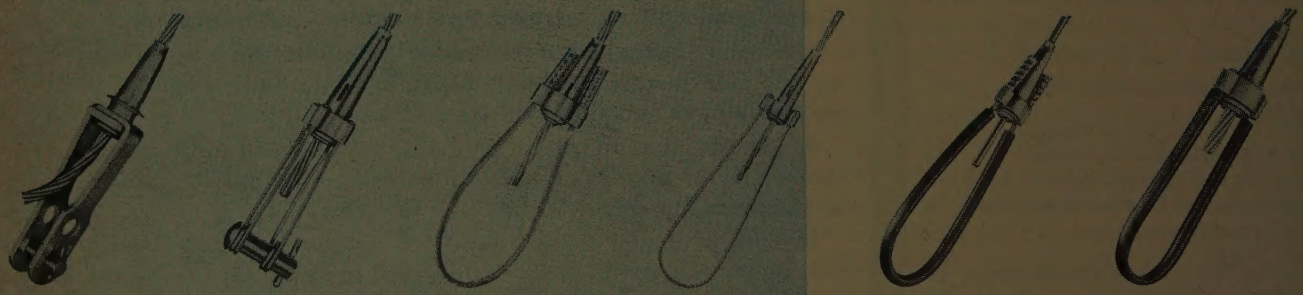
AL55266.8	266.8	4/0

FEED-THRU DEADENDS



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